



LOCAL STRUCTURE PLAN

LOT 2 (NO. 455) NORTH BEACH ROAD,
GWELUP



ROWEGROUP



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ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the City of Stirling Local Planning Scheme No.3.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

12TH JUNE 2017

Date

Signed for and on behalf of the Western Australian Planning Commission:

an officer of the Commission duly authorised by the Commission pursuant to section 16 of the Planning and Development Act 2005 for that purpose, in the presence of:

Ampalini

Witness

12 JUNE 2017

Date

12TH JUNE 2027

Date of Expiry





TABLE OF AMENDMENTS

Amendment No.	Summary of the Amendment	Amendment Type	Date Approved by WAPC
0	<i>Original Local Structure Plan</i>		



EXECUTIVE SUMMARY

This submission, prepared on behalf of Mr. Darron Baynham, the proponent of Lot 2 (No. 455) North Beach Road, Gwelup (herein referred to as the 'subject site') seeks support from the planning authorities to approve the proposed Local Structure Plan (LSP) prepared for the subject site.

The LSP has been prepared for 3.3411 hectares of land located within the Careniup Swamp Special Control Area for adoption under the provision of the City of Stirling, Local Planning Scheme No. 3.

The subject site is located approximately 15km north-west of the Perth CBD and is within 1km of the Mitchell Freeway and Reid Highway intersection. The subject site is adjacent to the Lake Karrinyup Country Club and is proximal to the Careniup Wetlands. The locality is predominantly residential in nature.

The LSP provides a framework for the future development of the subject land and a context for the consideration and approval of future residential subdivision applications. The LSP is therefore prepared to satisfy the requirements of *Local Planning Scheme No. 3* to facilitate subdivision and development of the site.


Structure Plan Summary Table

Item	Data	Section number referenced in report
Total area covered by the Structure Plan	3.3411 hectares	Part 1, Section 1.0
Area of each land use proposed:	Hectares	Lot yield
Residential	2.7116 hectares	64 lots
Public Open Space	0.6295 hectares	1 lot
Total estimated lot yield	64 lots	Part 2, Section 3.1
Estimated number of dwellings	64 dwellings	Part 2, Section 3.1
Estimated residential site density	R30	Part 2, Section 3.1
Dwellings per residential site hectare	23.6 dwellings	
Dwellings per gross urban hectare	19.1 dwellings	
Estimated population*	177 people @ 2.76 persons per household	Part 2, Section 3.1
Number of high schools	0 high schools	N/A
Number of primary schools	0 primary schools	N/A
Estimated commercial floor space (for activity centres if appropriate)	0 net lettable area	N/A
Estimated area and percentage of public open space given over to:		Part 2, Section 3.2
- Regional open space	N/A	
- District open space	N/A	
Estimated area and number:		Part 2, Section 3.2
- Neighbourhood parks	N/A	
- Local parks	0.6295 hectares, 1 park	
Estimate percentage of natural area	0.6295 hectares, 18.84%	



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▲ FIGURES

1. Regional Location
2. Local Location
3. Site Plan / Aerial
4. Metropolitan Region Scheme Zoning
5. Local Planning Scheme No.3 Zoning





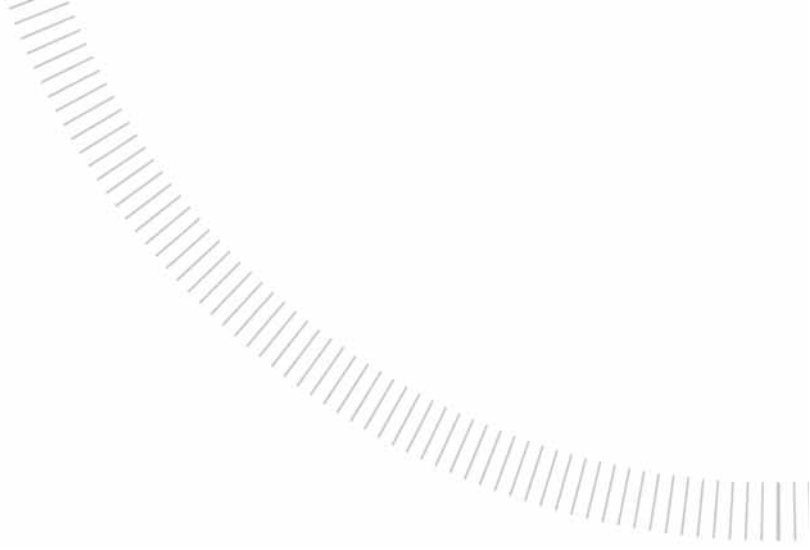
▲ TECHNICAL APPENDICES

Appendix Number	Document Title	Nature of Document	Referral/Approval Agency	Approval status and Modifications
1.	Certificate of Title	Supporting	N/A	
2.	Environmental Assessment Management Strategy	Supporting	N/A	
3.	Local Water Management Strategy	Requires Approval	Department of Water / City of Stirling	
4.	Bushfire Management Plan	Requires Approval	City of Stirling / DFES	
5.	Servicing & Infrastructure Report	Supporting	N/A	



Part One

IMPLEMENTATION



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1.Ā Structure Plan Area

This Local Structure Plan (LSP) shall apply to Lot 2 (No. 455) North Beach Road, Gwelup being the land contained within the inner edge of the line denoting the LSP boundary of the LSP map (refer Plan 1).

2.Ā Operation

This LSP shall come into operation on the date that it is approved by the Western Australian Planning Commission (WAPC).

3.Ā Staging

It is anticipated that the LSP area be developed in one stage.

4.Ā Subdivision and Development Requirements

4.1Ā Land Use Permissibility

The LSP map (refer Appendix 1) outlines land use, zones and reserves applicable within the LSP area in accordance with the zones and reserves listed in the Local Planning Scheme.

Land use permissibility within the LSP area shall be in accordance with the corresponding zone or reserve under the Scheme.

4.2Ā Residential Dwelling Target

Objective: To provide for a minimum of 63 dwellings within the LSP area.

4.3Ā Public Open Space

Public Open Space is to be provided generally in accordance with the LSP (refer Appendix 2) and Table 1 with an updated public open space schedule to be provided at the time of subdivision for determination by the WAPC, upon the advice of the City of Stirling. It is noted the provision of POS is also an outcome associated with Clause 6.2 of LPS No. 3, which is associated with the Careniup Swamp Special Control Area provisions.

POS Site	Size (HA)
POS	0.6295ha

5.Ā Local Development Plans

Local Development Plans may need to be prepared for lots:

- a)Ā Immediately adjoining public open space;
- b)Ā Where it is important to control vehicle access and egress;
- c)Ā Of an irregular shape or with an area of less than 350m²;
- d)Ā Narrow lots that require special conditions to be set;
- e)Ā Are subject to Fire Management requirements; and
- f)Ā Where otherwise deemed appropriate to the satisfaction of the City of Stirling.

Where necessary, Local Development Plans should address the following matters:

- 
- i.Ã Building envelope(s) – ground and upper floor setbacks, building envelopes, north boundary setback for solar access, nil setbacks.
 - ii.Ã Parking – location (mandatory or desired), potential additional parking for duplex-sized lots.
 - iii.Ã Vehicle access – location of vehicle access points,
 - iv.Ã Fencing – heights, detailing, retaining walls, developer-provided fencing.
 - v.Ã Services – easements.
 - vi.Ã Private Open Space – location of strategically important outdoor living areas.
 - vii.Ã Landscaping – location of existing trees to be retained in the street or in lots (as agreed with the Local Government).
 - viii.Ã Noise-buffering – location and type of noise-buffering and/or attenuation measures.
 - ix.Ã Ancillary dwellings and/or studio dwellings, home business or home workspace - potential location and size, parking provision and location.
 - x.Ã Encroachments – reciprocal rights of way, party walls.
 - xi.Ã Variations from State Planning Policy 3.1: Residential Design Codes.
 - xii.Ã Mechanisms for expiry or variations of Local Development Plans.

Local Development Plans should be consistent with the *Framework for Local Development Plans*.

6.Ã Local Water Management Strategy

6.1Ã Prior to the submission of an application for subdivision, an Urban Water Management Plan is required to be provided to and approved by the City of Stirling, on advice from the Department of Water and the Local Water Management Strategy to be updated to reflect outcomes of the Urban Water Management Plan.

7.Ã Other Requirements

7.1Ã Notifications

Notifications may be placed on the Certificates of Title for each affected lot to advise of the Bushfire Attack Level (BAL) assessment applicable to each lot and the associated construction requirements.

7.2Ã Infrastructure Requirements

There are no specific infrastructure requirements applicable to the structure plan area.

7.3Ã Funding Arrangements

There are no cost contribution arrangements applicable to the structure plan area.



- LEGEND**
- Local Structure Plan Boundary
 - Existing Boundaries
 - Proposed Boundaries
 - Residential - R30
 - Public Open Space
 - Road Pavement

0 7.5 Metres

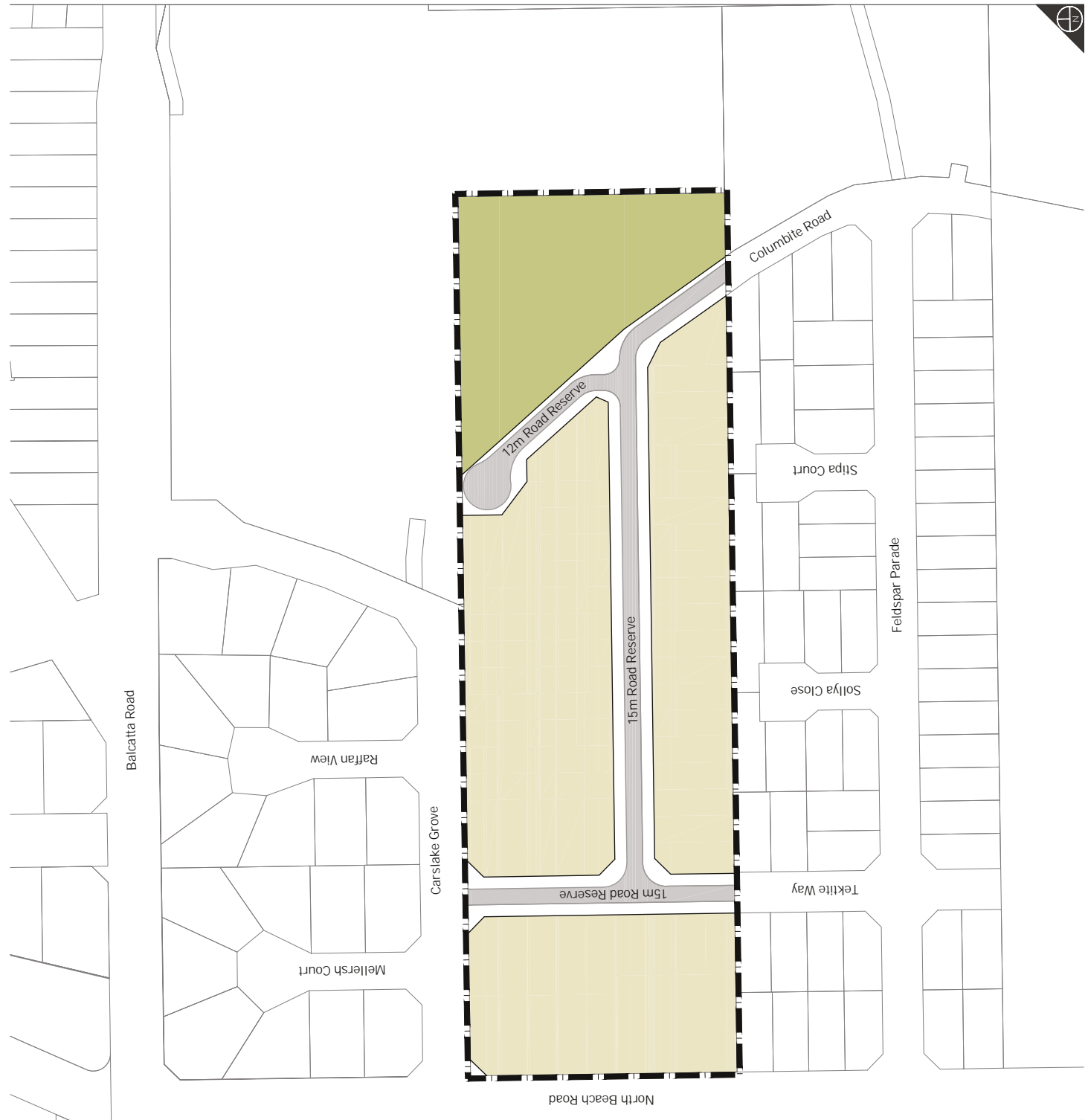
REVISIONS

Rev	Date	Drawn
A	2017.03.20	M. Sullivan



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 Job Ref: 8652
 Scale: 1:1 500 @ A3
 Client: D. Boyrham
 Designer: J. Holland
 Drawn: M. Sullivan
 Projection: MGA50.GDA94
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Cadastre supplied by LANDGATE



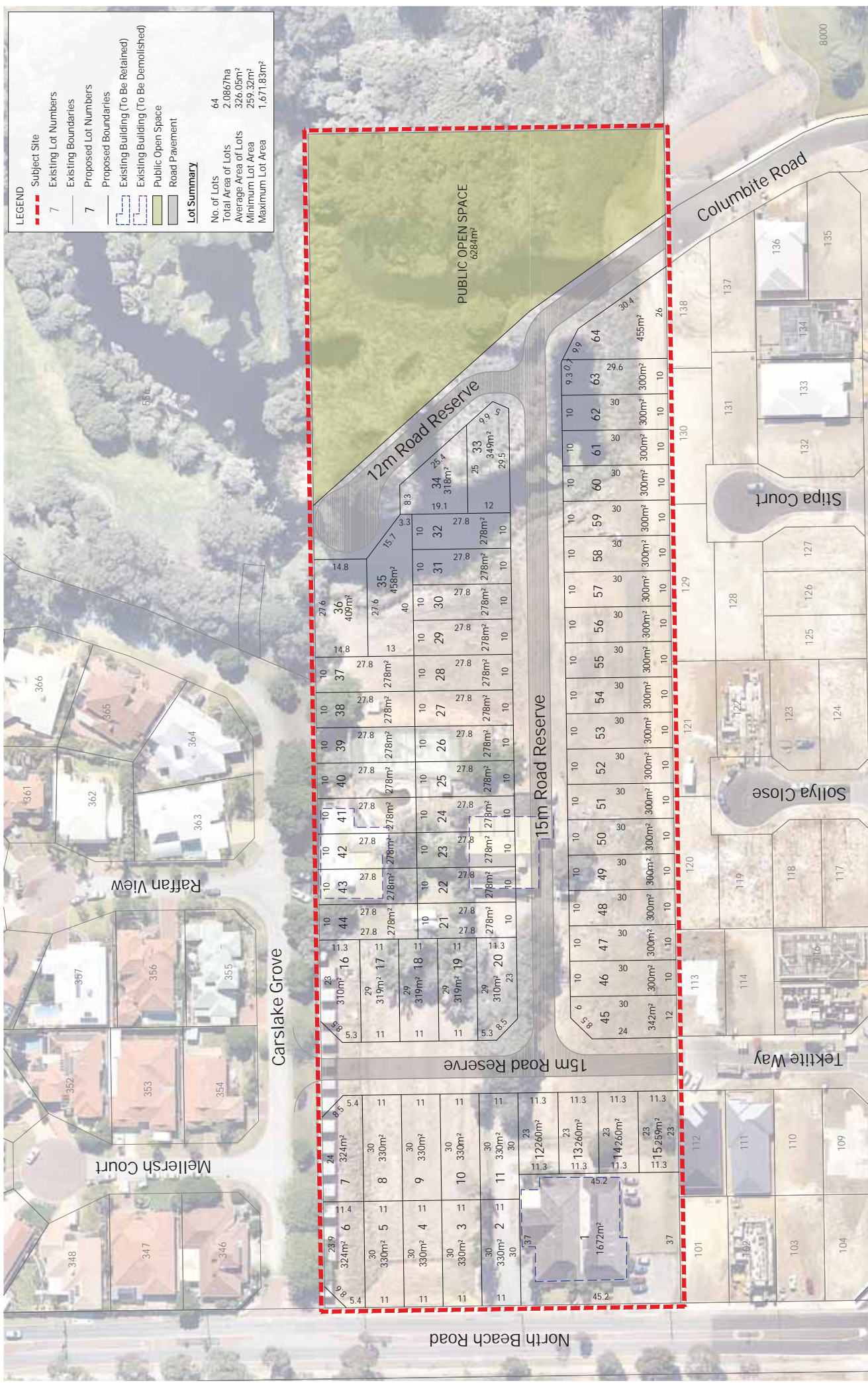
Lot 2 (No.455) North Beach Road Gwelup

Local Structure Plan

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Proposed Subdivision

Lot 2 (No. 455) North Beach Road, Gwelup





Part Two

EXPLANATORY SECTION



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01

Planning Background

1.1 Introduction and Purpose

The key objectives of the LSP are as follows:

- ▲ To provide a statutory framework to guide the use, subdivision and development of land to create a high quality urban environment.
- ▲ Capitalise on the natural amenity of the area afforded through the established Public Open Space reservation abutting the LSP area to the north east.
- ▲ To achieve an optimum lot yield with an emphasis of introducing a diverse product and associated housing choice into the area.
- ▲ Maximise opportunities for surveillance of the Public Open Space to enhance to amenity of the public realm and quality of living of the future residents.

1.2 Land Description

1.2.1 Location

The subject site is located within the suburb of Gwelup, within the municipality of the City of Stirling.

The subject site is located approximately 12 kilometres north of the Perth City Centre and approximately 5 kilometres from the Karrinyup Regional Centre which provides a range of services including retail, community and entertainment uses.

Figures 1 and 2 illustrate the location of the subject site.

1.2.2 Area and Land Use

The subject site is located on North Beach Road which runs along the western boundary of the subject site.

Currently, the subject site is used as a veterinary practice and as a residence by the Proponent.

Figure 3 illustrates an aerial photo of the subject site.

1.2.3 Legal Description and Land Ownership

The subject site has a total area of approximately 3.3411 hectares. The lot forming the LSP area and the respective ownership details are outlined in the table below.

Lot	Certificate of Title Volume / Folio	Land Ownership	Lot Area
2	1299 / 225	Darron Baynham	3.3411ha

Refer to Appendix 1 – Certificate of Title.

1.3 Planning Framework

1.3.1 Zoning and Reservations

1.3.1.1 Metropolitan Region Scheme

The subject land is zoned 'Urban Deferred' under the *Metropolitan Region Scheme (MRS)*. In view of the zoning under the City of Stirling Local Planning Scheme No.3, the proposal will not require the lifting of urban deferment to progress the Local Structure Plan.

Refer to Figure 4 – MRS zoning.

1.3.1.2 City of Stirling Local Planning Scheme No. 3

Under the provisions of the City of Stirling LPS No. 3 the subject site is zoned 'Development' and located within the Careniup Swamp Special Control Area.

The objective of the 'Development' zone is:

- a) *To provide for a coordinated development through the application of a comprehensive structure plan to guide subdivision and development.*
- b) *To avoid the development of land for purposes likely to compromise its future development for purposes, or in a manner likely to detract from the amenity or integrity of the area.'*

Although explained in much greater detail in section 3 of this report, the LSP aims to introduce an increased mix of residential densities to the Gwelup area in order to meet housing demands and affordability needs whilst protecting the amenity of the surrounding area.

Refer to Figure 5 – LPS No.3 zoning.

1.3.2 Regional and Sub-Regional Structure Plan

The subject site does not fall with a Regional or Sub-Regional Structure Plan area.

1.3.3 Planning Strategies

1.3.3.1 State Planning Strategy 2050


The State Planning Strategy 2050, was prepared by the WAPC and provides a strategic planning response to the challenges that Western Australia is likely to face in the future.

It envisages that by 2050 Western Australia will double its current population and will have a diverse range of well-connected and vibrant communities of the highest quality in the world.

The LSP will allow for the future development of currently vacant land for residential purposes which will contribute towards the goal to double the State's current population.

1.3.3.2 Directions 2031 and Beyond – A Spatial Framework for Perth and Peel

Directions 2031 provides the overarching strategic framework for the Perth and Peel Regions. Directions 2031 notes there is a need to introduce greater diversity in the new housing market to accommodate families. Directions 2031 seeks a 50% increase in the current average residential density of 10 dwellings per gross urban zoned hectare to 15 dwellings per gross urban hectare of land (which equates to approximately 23 dwellings per residential hectare of land) in new development areas. The LSP proposes a density coding of R30, which will contribute to meeting the forecast housing



needs of the City of Stirling and wider North Western Region and assist in increasing the current average residential density per hectare of the wider Perth and Peel region.

Further to this, the LSP will introduce needed housing diversity to meet housing demand and affordability within the Gwelup locality.

1.3.3.3 City of Stirling – Local Housing Strategy

The Local Housing Strategy (LHS) is a long term strategic project designed to increase residential development opportunities within the City.

The LHS identifies a deficiency in the number of medium density residential lots within the City noting that the typical lot sizes throughout the City are in excess of 500m².

As the proposed residential density coding is 'R30', the ODP will foster the development of lots around 300m² in size which will contribute towards satisfying the identified need for the introduction of medium density lots within the City of Stirling.

1.3.4 Planning Policies

1.3.4.1 Liveable Neighbourhoods

Liveable Neighbourhoods is the State Government's key policy for the design and assessment of structure plans. The policy sets out a number of objectives and principle aims to ensure the design and layout of new developments:

- ▲ Facilitate ease of access, in particular walking and cycling through a network of connected streets that are safe, efficient and pleasant;
- ▲ Foster a sense of community, place and local identity;
- ▲ Support an efficient public transport system;
- ▲ Provide a variety of lot sizes, housing types and densities that support the diverse housing needs;
- ▲ Conserve and incorporate key environmental areas into designs;
- ▲ Integrate the design of open space and stormwater management systems; and
- ▲ Maximise the use of land for housing.

The implementation of these elements is fundamental to ensuring structure planning and resultant subdivisions occur in a well-considered and sustainable manner. Application of the Liveable Neighbourhoods principles is therefore relevant to all levels of planning for the site from the proposed LSP through to detailed lot and building design.

Liveable Neighbourhoods specifically seeks densities in new urban areas to be at least 15 dwellings per urban hectare with an average of 22 dwellings per site hectare.

02

Site Conditions and Constraints

2.1 Biodiversity and Natural Area Assets

An Environmental Assessment and Management Strategy (EAMS) was undertaken by Emerge Associates for the subject site. A copy of the EAMS is contained in Appendix 2.


As outlined in the EAMS:

- ▲ The site has been historically cleared for agricultural purposes therefore remnant vegetation is limited to paddock trees and wetlands in the east of the site associated with Careniup Swamp.
- ▲ A Resource Enhancement Wetland (REW) UFI No. 8182, covers the east of the site, and is known as Careniup Swamp. This area has been historically disturbed, with extensive weed infestation throughout, and contains a mixture of remnant wetland values and artificial water bodies.
- ▲ An Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP) lake occurs in the east of the site.
- ▲ An Environmentally Sensitive Area (ESA) occurs in the east of the site and is also associated with the EPP Lake.
- ▲ Based on site inspections undertaken by Emerge ecologists, vegetation within the site is generally in "Completely Degraded" or "Degraded" condition (based upon the Bush Forever Condition Scale).
- ▲ No Threatened Flora (TF), Priority Flora (PF), Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) were recorded within the site.
- ▲ Permanently retained vegetation within and surrounding the site may present a bushfire hazard risk to development.
- ▲ The site occurs within a Priority 3 Public Drinking Water Source Area.
- ▲ Historic land uses within the site do pose potential contamination considerations, however based on the information at hand, there does not appear to be any significant contamination related impediments to the proposed land uses that cannot be addressed during subdivision and the associated works with a standard residential development.

Importantly, the EAMS acknowledges that through the administration and implementation of the LSP, the subject site will appropriately respond to the relevant environmental attributes of the site by:

1. Retaining vegetation within the Careniup Swamp core area in the east of the site;
2. Implement a LWMS as prepared by Hyd2o;
3. Ensure that future development appropriately responds to any bushfire hazards.

The EAMS appropriately recommends that at the subdivision stage, more detailed environmental requirements be addressed and these include:

- 
- ▲ An acid sulphate soil self-assessment process and management plan if required;
 - ▲ Preparation of a wetland management plan associated with the future public open space which will form part of the Careniup Swamp area;
 - ▲ Preparation of an urban water management plan (UWMP)

As a result of implementing appropriate environmental management practices such as those outlined above, the EAMS recognises that the proposed LSP manages the environmental attributes and values of the site and that the proposed residential use and development of the site is appropriate.

2.1.1 Wetlands

As discussed in the LWMS, Careniup Swamp is classified as a sump land, resource enhancement wetland. EPA's Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 also identifies part of the wetland as an EPP Lake.

As previously discussed, Careniup Swamp is identified as a Special Control Area under LPS No. 3 allowing for development to occur consistent with the detailed Careniup Swamp Rehabilitation Plan contained in City of Stirling LPS No. 3, which defines the core area of the wetland for retention following development.

Many existing and recent residential developments adjacent to Careniup Swamp intersect the mapped wetland boundaries.

2.2 Landform and Soils

Lithological logs undertaken on the subject site indicate that the subsurface profile is generally sandy with potential for areas of limestone at the western boundary of the subject site.

The eastern portion of the subject site is, according to environmental mapping, at a moderate to high risk of acid sulphate soil disturbance occurring within 3m of natural soil surface. This is a prevalent condition within this local area and is managed through specific acid sulphate management plans that are implemented during the subdivision implementation phase.


The subject site's landform and soil do not present any insurmountable restrictions to the intended residential development land use for the subject site.

2.3 Groundwater and Surface Water

A Local Water Management Strategy (LWMS) has been prepared by Hyd2o in support of the proposed LSP which analyses the subject site's pre-development ground and surface water. A copy of the LWMS is contained within Appendix 3. A summary of the LWMS is as follows:

The site is largely cleared and contains one existing residential dwelling and a veterinary practice. Careniup Swamp located to the east, is mapped as a resource enhancement wetland, with a smaller portion mapped as an EPP lake. The swamp forms part of the Water Corporations Main Drainage system, which services the adjacent residential area.

Topography of the site slopes from approximately 11 m AHD at the northern boundary to 10 m AHD at the western boundary and 6 m AHD at the eastern boundary. Elevated areas in the western portion of the site are located well above the groundwater table, with the water table expressing itself at natural surface in the east.



The proposed stormwater management system will retain and infiltrate the 1 in 1 year average recurrence interval (ARI) event on site, with events greater than 1 year ARI overflowing to Careniup Swamp in accordance with Water Corporation overarching drainage planning for the area.

This LWMS has been prepared in accordance with the principles, objectives, and key criteria of Better Urban Water Management (Western Australian Planning Commission, 2008). In excess of 40 years of groundwater and wetland water quality and level data from nearby Department of Water (DoW) bores, and 11 months of onsite measurements by Hyd2o, have been use to inform the development of this LWMS.

Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of Urban Water Management Plans for individual stages of development within the site.

However, in general terms, the subject site's surface water hydrology drains from west to east towards the Careniup Swamp via an overland flow. There are no defined drainage flow paths within the site and there are no external catchments contributing water flow into the subject site.


With respect to groundwater, the subject site has a low gradient flowing in an east-west direction with water levels ranging from 3.46m AHD to 5.65m AHD. The detailed provisions and management actions as outlined within the LWMS provide an appropriate water management approach for the subject site.

2.4 Bushfire Hazard

A Bushfire Management Plan (BMP) has been prepared by Emerge Associates in support of the proposed LSP in accordance with the bushfire protection criteria outlined within *State Planning Policy 3.7 – Planning in Bushfire Prone Areas* (WAPC 2015), the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017) and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009). A copy of the BMP is contained within Appendix 4.

The outcomes of this BMP indicate that the bushfire protection criteria outlined within the Guidelines (WAPC and DFES 2017) can be achieved as part of the proposed development. Bushfire risk will be managed through the following:

- ▲ Strategically locating, siting and designing the development to ensure buildings are not exposed to an unacceptable level of radiant flux, without appropriate mitigation measures. Separation will be provided between dwellings and post-development classified vegetation as part of subdivision of the site and will be implemented through the provision of APZs. APZs will be contained within road reserves, and through internal lot setbacks (where applicable). These areas will be maintained to an APZ standard in accordance with Clause 2.2.3.2 of AS 3959.
- ▲ Where within the proponent's landholding, the proponent will maintain areas within 100m of the development to a low threat standard in accordance with Clause 2.2.3.2 of AS 3959.
- ▲ An interconnected public road network will be provided within the development to facilitate the movement of people and emergency appliances, with access to Carslake Grove to the north and Tektite Way to the south, which will ensure at least two different vehicular access routes are available to all residents/the public at all times. One cul-de-sac is proposed in the LSP will be developed to standards in accordance with the Guidelines.

- 
- ▲ Providing a reticulated water supply and fire hydrants (to Water Corporation standards), which is a typical requirement of urban development, to ensure emergency services are able to respond to a bushfire event.

2.5 Heritage

A review of the Aboriginal Heritage Online Inquiry System confirmed there are no Registered Aboriginal Sites or Other Heritage Places over the subject lot.

There are no European Heritage sites currently listed on the Heritage Council of WA's (HCWA) State Register of Heritage Places or the City of Stirling's Municipal Heritage Inventory.

03

Land Use and Subdivision Requirements

3.1 Land Use

The proposed LSP provides for residential land uses consistent with the policy framework for the site and the existing and planned development to the south.

The residential blocks have been configured to respond to the shape of the land, solar orientation and to maximise vistas. Specifically, where possible, streets have been aligned in a west to east direction to enable view corridors to the proposed and existing POS surrounding the subject site to the east.

An overview of the LSP land uses and its key elements is provided in Table 1.


Table 1 – LSP Summary Public Open Space

Item	Data
Total area covered by LSP	3.3411ha
Area of each land use proposed:	
- Residential	2.7116ha
- Public Open Space	0.6295ha
Estimated Lot Yield	64 lots
Estimated Number of Dwellings	64 dwellings
Estimated residential site density	R30
Dwellings per residential site hectare	23.6 dwellings
Dwellings per gross urban hectare	19.1 dwellings
Estimated Population*	177
Number of High Schools	0
Number of Primary Schools	0
Estimated Commercial Floor Space	0
Number and % of Public Open Space:	
- Regional Open Space	0
- District Open Space	0
Estimated area and number:	
- Neighbourhood Parks	0
- Local Parks	0.6295ha

* Based on Australian Bureau of Statistics, Census of Population and Housing 2011 which states average household size in the City of Stirling to be 2.76 per dwelling.

3.2 Public Open Space

Normally, the provisions of Liveable Neighbourhoods citing public open space (POS) requirements would be of relevance. However, given that there is historical acceptance and expectations associated with the ceding of an area of land to form a rehabilitated Careniup Swamp, the normal 10% POS contribution is considered to be bypassed by the provisions of the Careniup Swamp Special Control Area provisions.



As such, the ceding of the land as designed as POS in the proposed LSP is considered to satisfy the POS expectations and requirements of the City of Stirling and relevant environmental agencies.

3.3 Residential

The LSP anticipates a yield of 64 residential dwellings at a residential density coding of 'R30'. The proposed density is intended to be sympathetic of the established residential character of Gwelup whilst introducing diversity of lot sizes and housing typologies to meet market and affordability demands in accordance with the strategic planning provisions.

The street blocks have been designed to maximise solar orientation (where possible) as well as view corridors to the proposed POS areas within the LSP area.

The proposed Lot 1 is to contain the existing Veterinary Hospital.

3.4 Movement Network

The proposed movement network effectively consists of roads which are in existence or planned for construction. That is, North Beach Road and Carslake Grove to the west and north, respectively, exist and will provide constructed road frontage to future proposed lots. The ultimate extension of Tektite Way and Columbite Road, recently constructed within the southern abutting Lot 500 North Beach Road, will provide internal connecting roads to the proposed LSP area.

It is important to note that the proposed extension of Columbite Road to the north through to Carslake Road is not proposed, for the following reasons:

- ▲ The topography of Reserve 11756 is not conducive to providing a connecting road into Carslake Grove. That is, the portion of Carslake Grove that runs north-south is substantially retained at a higher level from the POS;
- ▲ The existing bend in Carslake Grove where it changes from east-west to a north-south direction has poor line of sight around this corner movement due to the sloping topography. To provide another intersection at this potential junction will present traffic safety concerns;
- ▲ The north-south portion of Carslake Grove is in effect, a short cul-de-sac road which offers the existing residents a tranquil amenity environment. To locate an intersection road at this junction would introduce additional traffic from all southern residential development which would unnecessarily cause a detrimental impact to the existing tranquil amenity. Rather, having traffic focussed and directed to the existing east-west portion of Carslake Grove which carries intersecting traffic to Raffan View and Mellersh Court is considered a more appropriate amenity outcome; and,
- ▲ Extending a road through Reserve 11756 is beyond the subject site and requires involvement of the Department of Lands to consent to such a process. This is also considered an unnecessary process.

Notwithstanding the above, Columbite Road is designed to enter Lot 2 and continue in an east-west direction through to Tektite Way, with a cul-de-sac extending along the boundary to the open space area and terminate at the northern boundary. This will ensure that a public road interface is maintained to the POS area whilst avoiding the complications associated with the construction of a full road connection through to Carslake Grove.

3.4.1 Traffic Volumes

As a result of the forecasted subdivision and future development, traffic is expected to increase on the roads leading to and from the development including North Beach Road and Carslake Grove however will not anticipated that the capacity for these roads will be exceed.

The RTA NSW Guide to Traffic Generating Developments Version 2.2 (2002) indicates that approximately 5.5 vehicle trips per day (VPD) plus 0.8 per hour trips per dwellings will be generated from a development with an applicable density coding of R30.

The proposed Concept Plan indicates a total development yield of 64 lots, it is anticipated that the VPD will be approximately 370 VPD. Given that the future subdivision roads would likely be classified as a 'Neighbourhood Connector B' road under the provisions of Liveable Neighbourhoods, which has an indicated volume range of 3,000 VPD, the future development of the subject site is expected to have an insignificant impact on the existing road network.

3.4.2 Public Transport

There is an existing bus stop approximately 200 metres north-west of the subject site near the junction of North Beach Road and Balcatta Road. The stop is serviced by route 424 which provides a direct connection to both Karrinyup Shopping Centre and Cedric Street Train Station.

3.4.3 Pedestrian and Cycle Access

It is intended that pedestrian and cycle access will be provided internally within the subject site to provide ease of movement, especially in and around the proposed POS areas.

3.4.4 Service Vehicles

The internal layout of the proposed development will support the access and egress of service vehicles such as waste removal trucks in a forward motion.

3.4.5 Water Management

A LWMS has been prepared by Hyd2o to support the proposed LSP. The LWMS sets out management requirements for water management at the regional, local and lot scale, including specific targets (design objectives) for the management of surface and groundwater quantity and quality. The LWMS assists in integrating land and water planning as required by *State Planning Policy 2.9 Water Resources and Better Urban Water Management*.

The water management for the proposed LSP and future development of the subject site is based upon the best practice water sensitive urban design which is achieved through maximising the sustainable use of water through the encouragement of water conservation and efficiency measures.


3.4.6 Servicing and Infrastructure

To ensure that the intended residential development outcome is feasible from a servicing and infrastructure perspective, a report by civil engineering consultancy, Serling Consulting, was prepared to ensure that there is sufficient infrastructure and capacities to suit the ultimate residential development outcome. A copy of the servicing and infrastructure report is contained in Appendix 5.

In summary, there are no servicing or infrastructure impediments to the residential subdivision and associated development of the subject site.

3.5 Education Facilities

The site has not been identified as required for the provision of educational facilities within the locality.



Existing educational facilities are located in close proximity to the site; consisting of:

- ▲ Lake Gwelup Primary School
- ▲ Carine Senior High School
- ▲ Balcatta Senior High School

In view of the existing provision and the scale of the proposed subdivision, no educational facilities are proposed within the LSP area.

Activity Centres and Employment

3.6 Activity Centres and Employment

The LSP does not propose any commercial or retail uses, aside from the continued operation of the Veterinary Hospital on the site, which is reflective of the current strategic planning for the locality as detailed below.

3.6.1 Strategic Metropolitan Centres

In accordance with *State Planning Policy 4.2: Activity Centres for Perth and Peel* (SPP 4.2), the closest strategic metropolitan centre to the LSP area is Stirling (approximately 2.5 kilometres to the south-east).

Beside the Perth City Centre (Strategic Metropolitan Centre), this centre comprises the main regional activity centre within relatively close proximity to the LSP. They provide a diversity of uses, providing for a range of economic and community services required to service the future population.

3.6.2 Secondary Centres

In accordance with *State Planning Policy 4.2: Activity Centres for Perth and Peel* (SPP 4.2), the closest secondary centres to the LSP area are Karrinyup (approximately 2 kilometres to the south-west) and Warwick (approximately 2.5km to the north-east).

The secondary centres share similar characteristics to Stirling as the strategic metropolitan centre but service a smaller catchment and offer a more limited range of services.

3.6.3 District Centre

Current strategic planning identifies District Centres at Greenwood (approximately 3.5km to the north) and Sorrento (approximately 3.5km to the north-west).

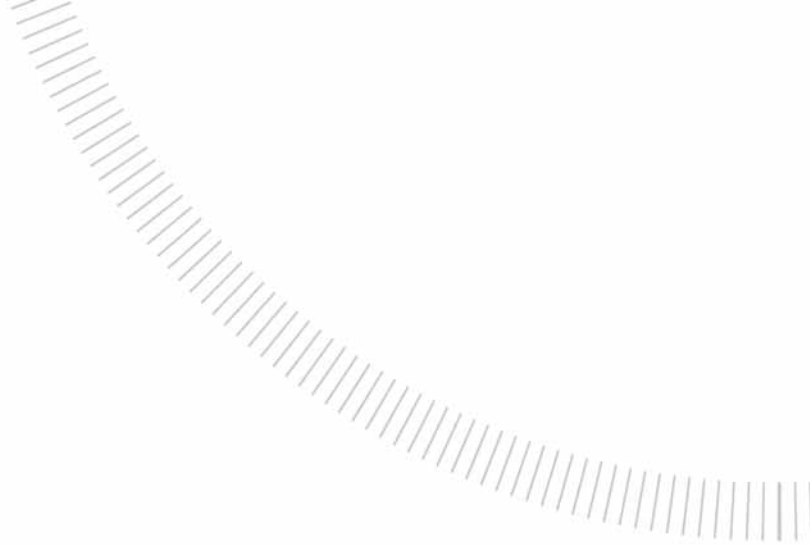
These centres incorporate numerous supermarkets and a wide range of complementary specialty shops which are capable of servicing the daily and weekly needs of the catchment.

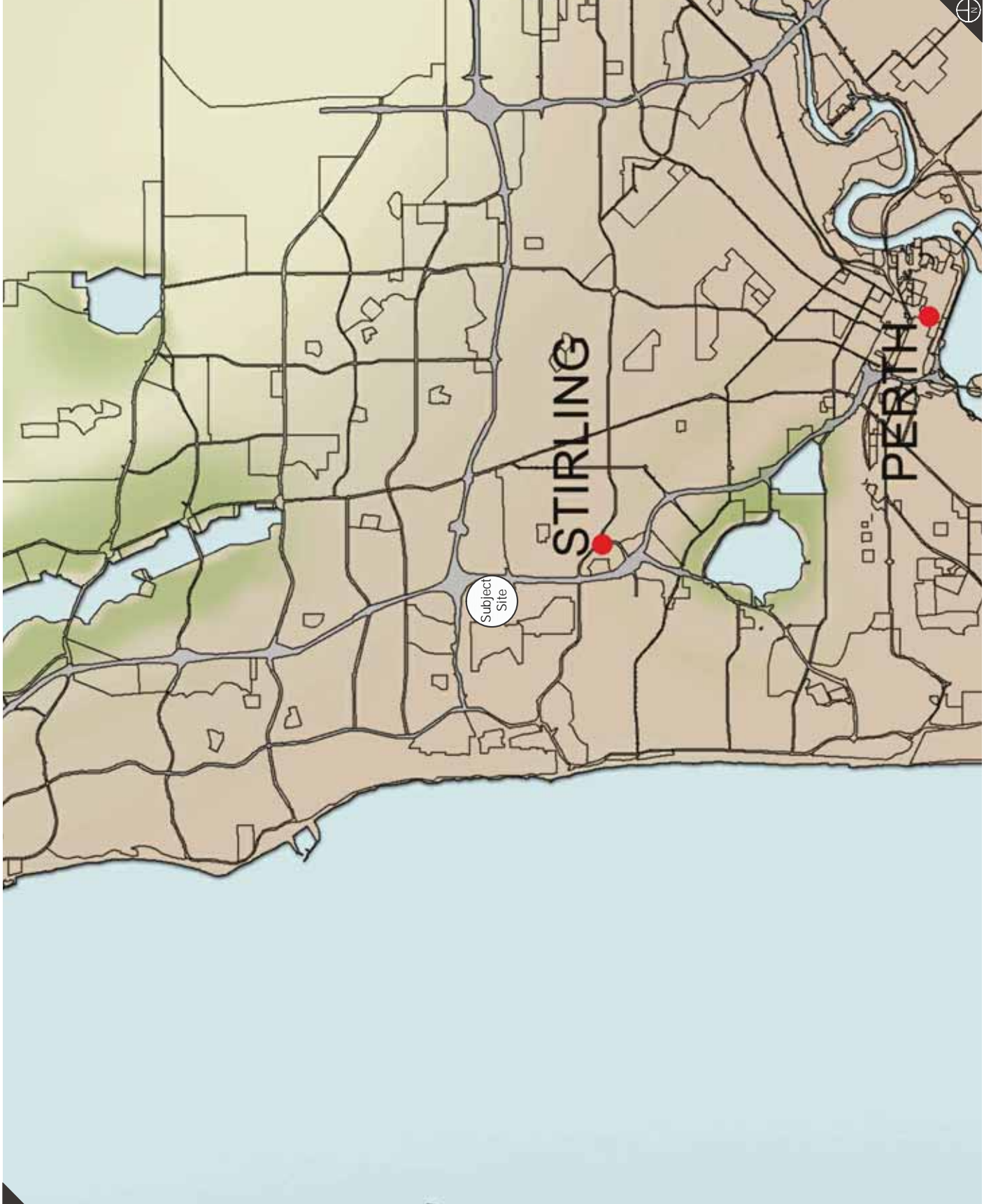
3.6.4 Neighbourhood / Local Centre

Consistent with the draft LCAC Policy, the LSP does not propose a Neighbourhood or Local Centre within the LSP area. The existing Primewest Gwelup Shopping Centre on North Beach Road, less than 2km south of the LSP area, would provide for the daily and weekly household shopping needs together with a small range of convenience services



FIGURES





Regional Location

Lot 2 (No.455) North Beach Road
Gwelup

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A	2017.02.02	M. Sullivan



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Job Ref: 8652
Scale: NTS @ A4
Client: D. Beynham
Designer: J. Holland
Drawn: M. Sullivan

Projection: MGA60 GDA94
Plan ID: 8652-FIG-01-A

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LEGEND
--- Subject Site

0 125 Metres

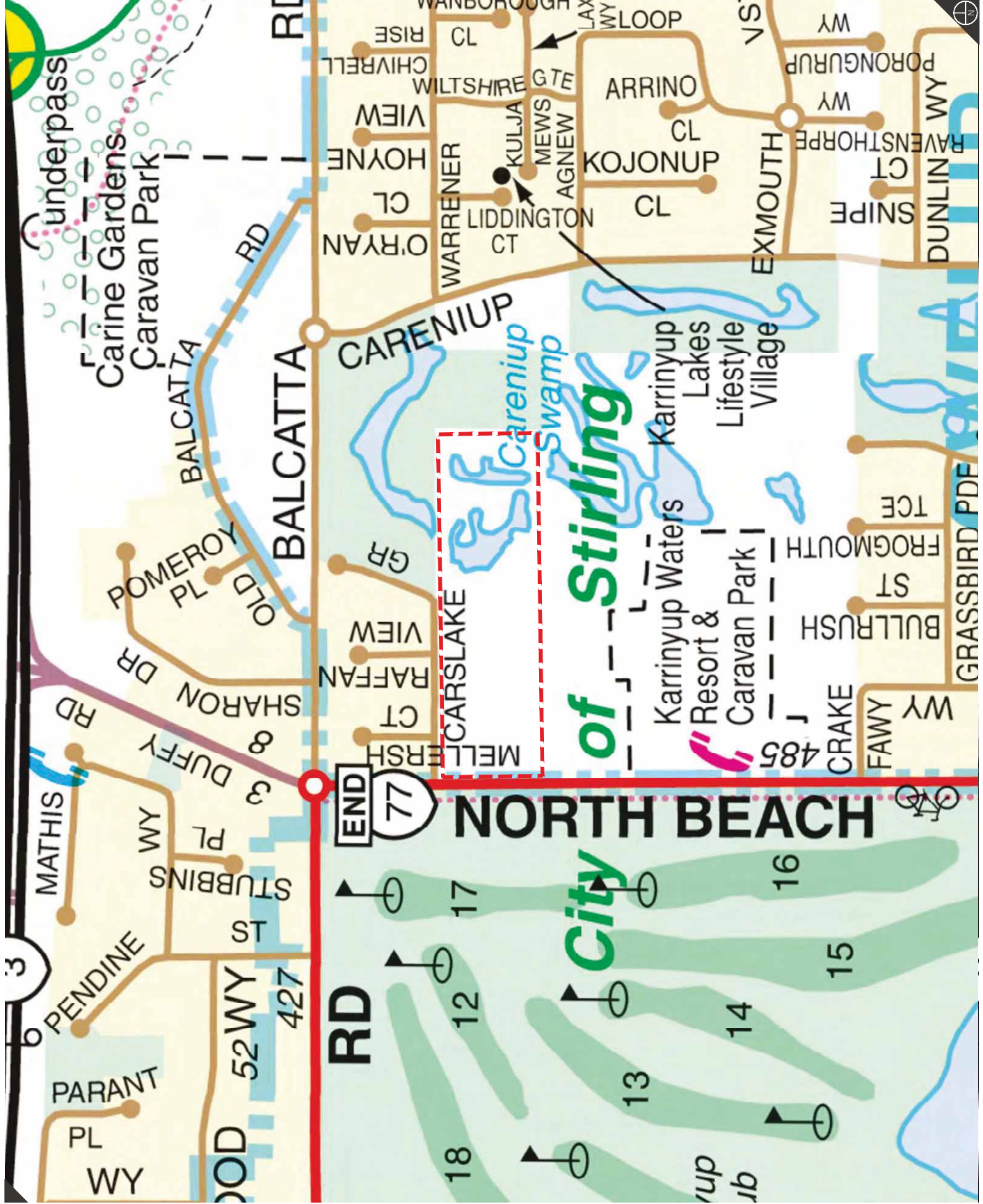
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Lot 2 (No.455) North Beach Road
 Gwelup

Local Location

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 Matt Sullivan 2 February 2017

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LEGEND

- Subject Site
- Contours
- 7 Existing Lot Numbers
- Existing Boundaries
- Water
- Sewer

0 50 Metres

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Lot 2 (No.455) North Beach Road
Gwelup

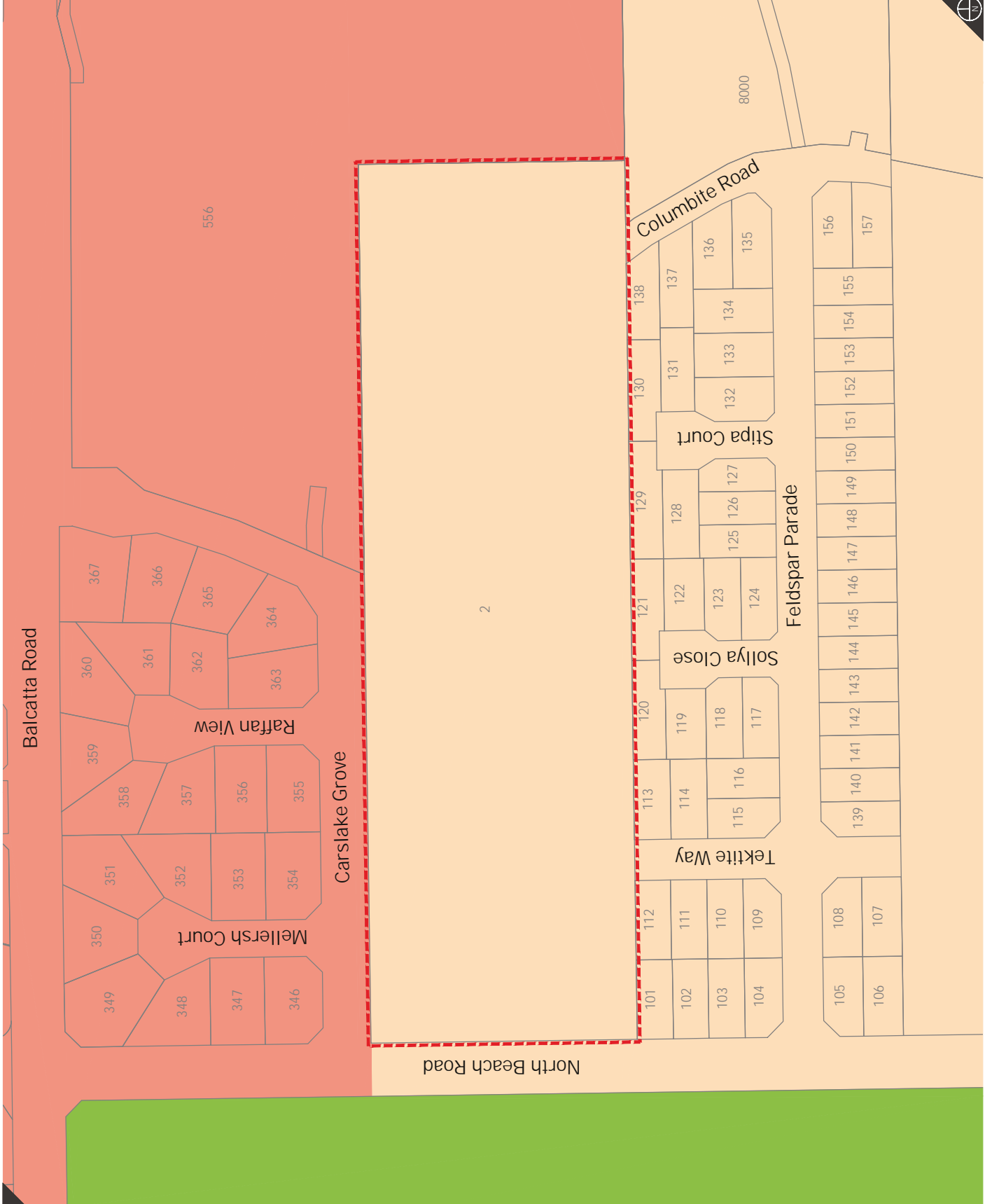
Site Plan

N:\TOWN PLANNING\8000-8999\6452\DRAWINGS\A-CAD\8652_FIG03A_20170202 GWELUP (SITE).DWG
Matt Sullivan 2 February 2017

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- LEGEND**
- Subject Site
 - Existing Lot Numbers
 - Existing Boundaries
- ZONES**
- Urban
 - Urban Deferred
 - Private Recreation



0 50 Metres

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Metropolitan Region Scheme Zoning

Lot 2 (No.455) North Beach Road
 Gwelup

Figure 4

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LEGEND

- Subject Site
- Existing Lot Numbers
- Existing Boundaries
- LOCAL SCHEME RESERVES
- Public Open Space
- LOCAL SCHEME ZONES
- Development
- Residential
- Private Institution
- OTHER
- No Zone
- S1 Special Use Area
- R Codes
- Special Control Area

0 50 Metres

REVISIONS

Rev	Date	Drawn
A	2017.02.02	M. Sullivan



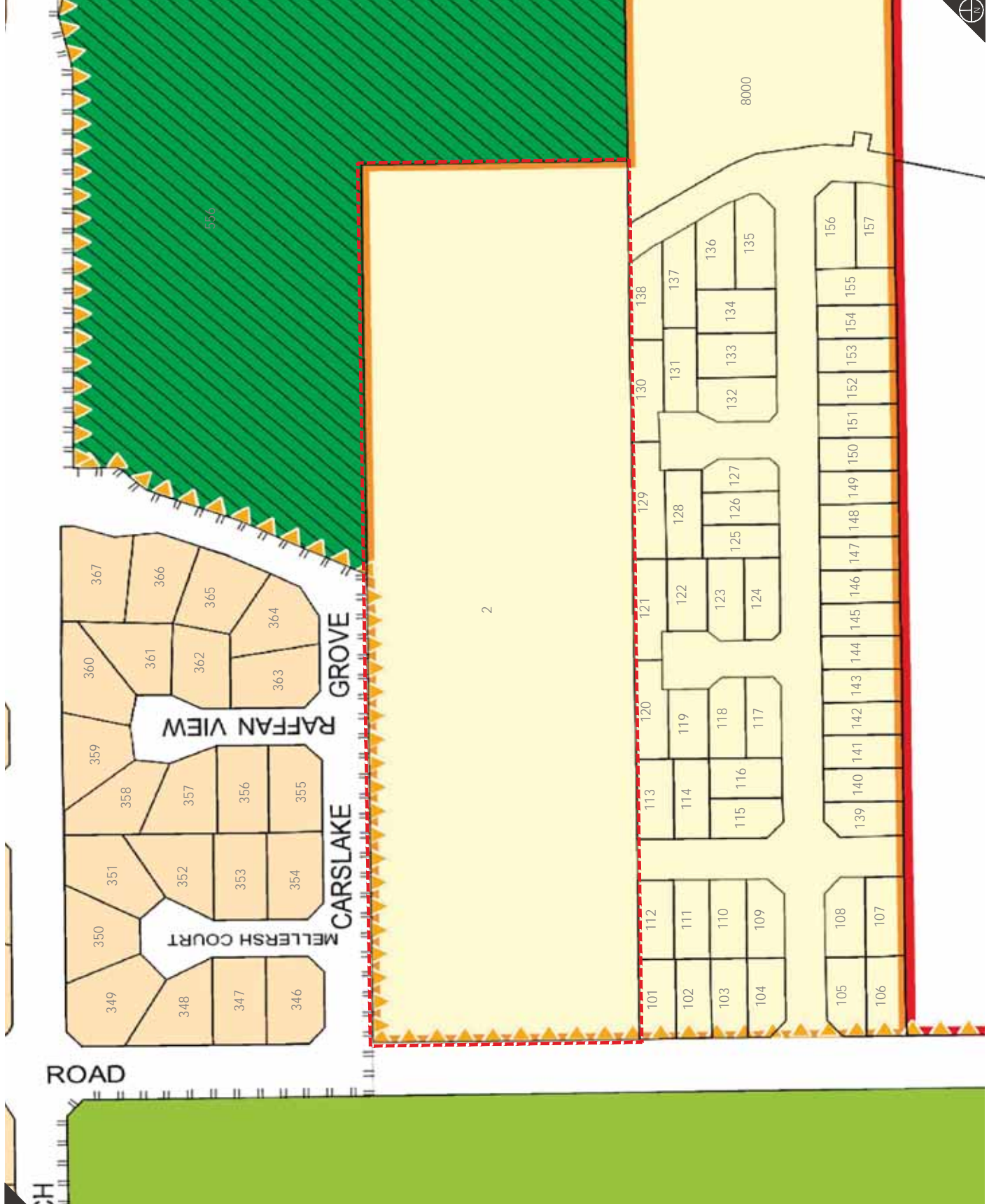
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Map supplied by WA Planning Commission

Figure 5



Lot 2 (No.455) North Beach Road
 Gwelup

Town Planning Scheme No.3 Zoning

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Part Three

TECHNICAL STUDIES APPENDICES



ROWEGROUP



APPENDIX 1

CERTIFICATE OF TITLE



ROWEGROUP

WESTERN



AUSTRALIA

REGISTER NUMBER 2/P3318	
DUPLICATE EDITION 2	DATE DUPLICATE ISSUED 17/1/2014

RECORD OF CERTIFICATE OF TITLE
UNDER THE TRANSFER OF LAND ACT 1893

VOLUME
1299

FOLIO
225

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.



REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 2 ON PLAN 3318

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

DARRON JAMES BAYNHAM OF 455 NORTH BEACH ROAD, GWELUP
(T K558613) REGISTERED 7 APRIL 2008

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE. VOL 1299 FOL 225.
2. M398868 LEASE TO IVYBRIDGE PTY LTD OF 455 NORTH BEACH ROAD, GWELUP EXPIRES: SEE LEASE. AS TO PORTION ONLY REGISTERED 10.9.2013.
M398869 SUB-LEASE OF LEASE M398868 TO ALATI PTY LTD OF CARE OF PAIOFF PARTNERS PTY LTD, SUITE 12, 643 NEWCASTLE STREET, LEEDERVILLE EXPIRES: SEE SUB LEASE. REGISTERED 10.9.2013.
M398870 MORTGAGE OF SUB-LEASE M398869 TO WESTPAC BANKING CORPORATION REGISTERED 10.9.2013.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 1299-225 (2/P3318).
PREVIOUS TITLE: 1072-596.
PROPERTY STREET ADDRESS: 455 NORTH BEACH RD, GWELUP.
LOCAL GOVERNMENT AREA: CITY OF STIRLING.



APPENDIX 2

ENVIRONMENTAL ASSESSMENT MANAGEMENT STRATEGY



ROWEGROUP

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY

455 (LOT 2) NORTH BEACH ROAD LOCAL
STRUCTURE PLAN

Project Number EP15-021(01)

Prepared for Darron Baynham
March 2017



ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY
455 (LOT 2) NORTH BEACH ROAD LOCAL STRUCTURE PLAN

Document Control

DOC NAME	ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY				
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REVISION	DATE	AUTHOR		REVIEWER	
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	Draft report for review by client/project team.				
A	June 2015	Vanessa Keating	VMK	Jason Hick	JDH
	Final report for submission to City of Stirling.				
B	March 2017	Dylan Martini	DCM	Jen Longstaff	JL
	Revised to incorporate updated Local Structure Plan				
C					
D					

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Executive Summary

Emerge Associates was engaged by Darron Baynham (the proponent) to provide a suite of environmental services to support the preparation of a Local Structure Plan (LSP) for 455 (lot 2) North Beach Road, Gwelup, in the City of Stirling (“the site”). This has included numerous investigations to identify and assess the environmental attributes and values within the site.

The site is approximately 3.4 ha in size and is bound by North Beach Road to the west, Carslake Grove the north, Careniup Swamp to the east, and a separate urban subdivision to the south. The site is zoned “Development” under the City of Stirling’s Local Planning Scheme (LPS) No. 3, and falls within the Careniup Swamp Special Control Area. Special Control Areas are subject to specific provisions in addition to those applicable to the underlying LPS zoning.

This report has been prepared to address the requirements of the Western Australian Planning Commission’s (WAPC) *Structure Plan Preparation Guidelines* (WAPC 2012) to support the Structure Plan design and implementation, and provides a synthesis of information from a range of sources regarding the environmental features, attributes and values of the site. This includes existing information, plus site specific assessments and reporting that have been undertaken over the site including:

- Local Water Management Strategy (Hyd2o 2015).
- Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting Pty Ltd 2017).
- Preparation of a Landscape Master Plan (FIT Landscape 2015)
- Preparation of a Geotechnical Investigation Report (CMW Geosciences 2015)

Based on the above information, the environmental attributes and values identified within the site have been outlined in **Section 2** and include:

- The site has been historically cleared for agricultural purposes therefore remnant vegetation is limited to paddock trees and wetlands in the east of the site associated with Careniup Swamp.
- A Resource Enhancement Wetland (REW) UFI No. 8182, covers the east of the site, and is known as Careniup Swamp. This area has been historically disturbed, with extensive weed infestation throughout, and contains a mixture of remnant wetland values and artificial water bodies.
- An Environmentally Sensitive Area (ESA) occurs in the east of the site
- Based on site inspections undertaken by Emerge ecologists, vegetation within the site is generally in “Completely Degraded” or “Degraded” condition (based upon the Bush Forever Condition Scale).
- No Threatened Flora (TF), Priority Flora (PF), Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) were recorded within the site.
- The site occurs within a Priority 3 Public Drinking Water Source Area.
- Historic land uses within the site do pose potential contamination considerations, however based on the information at hand, there does not appear to be any significant contamination related impediments to the proposed land uses that cannot be addressed during subdivision and the associated works with a standard residential development.
- The site is currently used for livestock grazing activities, and supports a veterinary clinic and a residential dwelling. However, it is located in a broader local area that is targeted for and suited to residential infill development.
- Permanently retained vegetation within and surrounding the site may present a bushfire hazard risk to development.

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY

455 (LOT 2) NORTH BEACH ROAD LOCAL STRUCTURE PLAN

The LSP (provided in **Appendix A**) has responded to the environmental values and attributes of the site and outlines an environmental management framework that will be progressed through the relevant stages of the planning process and development of the site.

Specifically the LSP has responded to the environmental values and attributes of the site through:

- Retention of vegetation within the Careniup Swamp core area in the east of the site
- Preparation of a Local Water Management Strategy (Hyd2o 2015) in accordance with Better Urban Water Management (BUWM) (WAPC 2010).
- Preparation of a Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2017) and placement of a road reserve and managed public open space to interface with the wetland core area to accommodate an Asset Protection Zone required to manage bushfire threats resulting from retained vegetation within the core area.

Further environmental management requirements can be addressed through future planning approvals, and specifically through subdivision conditions likely to be required for the development that could include:

- Preparation of an ASS self-assessment in accordance with model subdivision condition EN8 (WAPC 2016) and potentially undertaking further detailed ASS investigations and management plans depending on the subdivision construction methodology.
- Preparation of a Wetland Management Plan in accordance with model subdivision condition EN1 (WAPC 2016).
- Preparation of an Urban Water Management Plan in accordance with model subdivision condition D2 (WAPC 2016).
- Addressing any contamination within the site as per model subdivision condition EN9 (WAPC 2016).
- A detailed Bushfire Attack Level (BAL) assessment for proposed buildings within declared bushfire prone areas, as outlined in the Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2017) for the site, as part of the subdivision or building approval process for residential dwellings.
- Place a notification on the titles of those proposed lots that are subject to bushfire risk, as per model subdivision condition F8 (WAPC 2016).

They key environmental consideration for the site would initially appear to be the mapped extent of the REW areas within the site. Notwithstanding this, based on our background investigations, it is apparent that large portions of the mapped wetland area do not support important wetland values. In addition to this, at a broader scale, the Careniup Swamp (of which the wetland areas within the site form a part of) has been specifically considered by the City of Stirling within LPS No. 3 (in terms of both spatial requirements and scheme provisions) and has been formally supported by the EPA. The LSP layout and framework is consistent with this and therefore presents an environmentally acceptable outcome to resolving the broader wetland system delineation and future management requirements.

Overall, the environmental attributes and values of the site can be accommodated within the LSP design or can be managed through the future subdivision and development stages in accordance with relevant federal, state and local government legislation, policies and guidelines and best management practices. As such, the proposed future development of the site is not expected to significantly impact on the environmental values and attributes of the site.

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY
455 (LOT 2) NORTH BEACH ROAD LOCAL STRUCTURE PLAN

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Appendices

Appendix A

Local Structure Plan (Rowe Group 2017)

Appendix B

Letter of Advice from the EPA (dated 27 December 2012)

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY
455 (LOT 2) NORTH BEACH ROAD LOCAL STRUCTURE PLAN

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1 Introduction

1.1 Background

Rowe Group, on behalf of Darron Baynham, have prepared a revised Local Structure Plan (LSP) for the urban development of 455 (Lot 2) North Beach Road, in the locality of Gwelup, within the City of Stirling. This area is herein referred to as “the site.”

The site is approximately 3.4 hectares (ha), located approximately 12 kilometres (kms) north-west of the Perth Central Business District (CBD) and is bound by North Beach Road to the west, Carslake Grove the north, Careniup Swamp to the east, and a separate residential subdivision to the south. The location of the site is shown in **Figure 1**.

1.2 Purpose of Report

This report provides a synthesis of information regarding the environmental attributes and values of the site. It is based on a range of information sources including local and regional reports, databases and publically available mapping, and where existing, site specific surveys and investigations. Together, this information has been used to inform the layout of the LSP, shown spatially in **Figure 2** and attached in **Appendix A**, and the preparation of the LSP supporting documentation for the site.

The primary purpose of this report is to present the information that was used to inform the preparation and design of the LSP, assess the potential environmental impacts that could arise from implementation of the plan, outline the responses in the LSP to accommodate the environmental values and attributes and specify an environmental management framework for the future subdivision and development process.

1.3 Environmental and site specific investigations

Emerge Associates have been engaged to provide a suite of environmental services to support future urban development within the site. This has included numerous investigations to identify and assess the environmental attributes and values present within the site, utilising a range of information sources including local and regional reports, databases and mapping.

Other than this document, these investigations have included the following:

- Undertaking a desktop level assessment to identify environmental values and attributes within the site, and a site visit by EmERGE environmental personnel to confirm the findings of the desktop assessment.
- Undertaking a preliminary flora and vegetation assessment to inform the *Environmental Assessment and Management Strategy* (EmERGE Associates 2015).
- Preparation of a *Bushfire Management Plan* (EmERGE Associates and Bushfire Safety Consulting Pty Ltd 2017).

In addition to the above, there have been a number of investigations undertaken by a broader project consultant team to understand the environmental attributes and values to support development within the site, and work to date over the site and local area has included:

- Preparation of a *Local Water Management Strategy* (Hyd2o 2015)

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- Preparation of a *Landscape Master Plan* (FIT Landscape 2015)
- Preparation of a *Geotechnical Investigation Report* (CMW Geosciences 2015)

2 Existing Environment and Site Specific Investigations

2.1 Local Context

The site is approximately 3.4 ha in size and is bound by North Beach Road to the west, Carslake Grove the north, Careniup Swamp to the east, and a separate urban subdivision to the south. The site is zoned "Development" under the City of Stirling's Local Planning Scheme (LPS) No. 3, and falls within the Careniup Swamp Special Control Area under the City of Stirling's LPS No. 3. Special Control Areas are subject to specific provisions in addition to those applicable to the underlying LPS zoning.

2.2 Climate

The climate of the site (which applies to the wider Perth metropolitan region) is described as Mediterranean, with hot, dry summers and moderately wet, mild winters.

The majority of rainfall within the region occurs between May and October each year, and on average is between 600 to 1000 mm per year. However, in the last 40 years there has been a marked decrease in rainfall (between 10 to 15 % decrease), with a noticeable shift to a drier climate across the south-west of Western Australia.

The closest weather station to the site which records rainfall and temperature is at the Perth Metro station, located approximately 9 km south-east of the site. Average monthly rainfall and minimum and maximum temperatures (1994 – April 2015) are summarised in **Table 1** below.

Table 1: Temperature and rainfall averages for the Perth Metro weather station (1994 – April 2015) (BoM 2015)

STATISTICS	J	F	M	A	M	J	J	A	S	O	N	D
Mean Maximum Temperature	31.2	31.7	29.6	25.9	22.4	19.3	18.4	19.1	20.3	23.3	26.5	29.1
Mean Minimum Temperature	18.1	18.4	16.6	13.8	10.6	8.5	7.6	8.3	9.6	11.4	14.2	16.4
Mean Rainfall (mm)	15.4	8.8	20.5	35.7	90.5	127.9	146.7	122.8	89.6	39.5	23.8	9.9

2.3 Landform and soils

2.3.1 Topography

The site is generally flat with an easterly aspect. Available contour information indicates that the site ranges from its lowest elevation of approximately 7 metres Australian Height Datum (m AHD) in the east, to its highest elevation of approximately 10 m AHD in the west.

The available contour information for the site is shown in **Figure 3**.

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2.3.2 Regional geomorphology, landform and soils

The site is located in the central part of the Swan Coastal Plain, which forms the central portion of the Perth Basin. The Perth Basin extends from the Darling Fault in the east to the continental slope west of Rottnest Island, and from the Murchison River in the north to the Southern Ocean in the south. The Perth Basin is sedimentary in origin and is marginal to the west of the Australian Shield (Seddon 2004).

The Swan Coastal Plain is composed of two wide belts of sediment that differ in origin, with one formed from alluvial deposits (water-laid) and the other formed from aeolian origins (wind-laid). It is approximately 20 to 30 kilometres wide, consisting of a series of geomorphic entities that run parallel to the coastline with the alluvial deposits in the east and the aeolian deposits in the west. The youngest and western most geomorphic entity of aeolian origin is the Quindalup Dunes, followed by the Spearwood Dunes and the Bassendean Dunes (Beard 1990, Seddon 2004). The Pinjarra Plain follows the Bassendean Dunes and is alluvial in origin, which then joins the Ridge Hill Shelf at the eastern most edge of the Swan Coastal Plain.

The site forms part of the Spearwood dune system, which largely consist of yellow-brown siliceous sands over limestone and ranges from hilly to gently undulating terrain (Seddon 2004). The underlying geology of the site is Tamala limestone, overlain by Safety Bay sands (Gozzard 1983).

There are two soil formations within the site: the Herdsman formation which occupies the majority of the site and the Karrakatta formation which is found at the western edge of the site. These are shown in **Figure 4**. Both the Herdsman and Karrakatta formation are of aeolian origin. The Herdsman formation is described as comprising peaty swamps associated with Bassendean and Karrakatta units (Churchward and McArthur 1980). The Karrakatta formation consists of an undulating landscape with deep yellow sands over limestone (Churchward and McArthur 1980).

2.3.3 Acid Sulfate Soils

Acid Sulfate Soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state ASS are generally present in waterlogged anoxic conditions and do not present any risk to the environment. When oxidised, ASS produce sulphuric acid, which can pose risks to the surrounding environment, infrastructure and human health.

Available information (Department of Environment and Conservation (DEC) 2010) indicated that the majority of the site has been classified as having a 'no known risk' of ASS occurring within three metres of the natural soil surface, while the east of the site has a 'Moderate to High' risk of ASS occurring within three metres of the natural soil surface, as shown in **Figure 5**.

Detailed ASS investigations previously undertaken for the site (Cardno BSD 2007) indicate that Actual ASS (AASS) do not occur within the site, however Potential ASS (PASS) are located below a depth of 3.5 m below ground level (BGL) in the east of the site. This is consistent with the publically available ASS mapping for the site.

2.4 Biodiversity and Natural Assets

2.4.1 Flora and Vegetation

2.4.1.1 Regional vegetation context

The site lies within the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) region (Thackway and Cresswell 1995). This region is characterised by *Banksia* or Tuart on sandy soils, *Allocasuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland (DEC 2013).

Vegetation complex mapping undertaken by Heddle *et al.* (1980), which uses a combination of landform, soil and rainfall parameters, indicates that the majority of the site comprises the Herdsman complex. The Karrakatta Central and South complex is also mapped in a small portion at the western extent of the site. The Herdsman complex is described as comprising sedgeland and fringing woodland of *Eucalyptus rudis* (flooded gum) - *Melaleuca* spp. (Heddle *et al.* 1980). The Karrakatta Central and South complex is described as containing open forest of tuart - jarrah – marri (Heddle *et al.* 1980). The landform mapping shown in **Figure 4** also reflects the spatial layout of the Heddle (*et al.* 1980) vegetation complex mapping.

Remnant vegetation extents according to vegetation complex statistics have been published by the Western Australian Local Government Associations (WALGAs) Local Biodiversity Program. These statistics indicate that the pre-European extent of the Herdsman complex on the Swan Coastal Plain was 8,309 hectares (ha). As of 2013, 2877 ha (35%) of this remains and 25% of the complexes original extent is under formal or informal protection (Perth Biodiversity Project 2013). The pre-European extent of the Karrakatta Central and South complex was 49,786 ha. As of 2013, 11,906 ha (24%) remains with 9% under formal or informal protection (Perth Biodiversity Project 2013).

Many studies have indicated that the loss of biodiversity caused by habitat fragmentation is significantly greater once a habitat type falls below 30% of its original extent (Miles 2001). However this is a purely biodiversity orientated objective, and on the Swan Coastal Plain portion of the Perth Metropolitan Region, which is considered a 'constrained area', the Environmental Protection Authority (EPA) has applied a biodiversity protection objective of retaining 10% of each vegetation complex (EPA 2006a). Based on this, the extent of the Herdsman Complex and the Karrakatta Central and South Complex remaining exceeds the 10% constrained area objective.

2.4.1.2 Extent and condition of remnant vegetation

The majority of the site was historically cleared of remnant vegetation and subsequently used for extensive agricultural purposes. As such, the majority of the site is now made up of scattered planted *Agonis flexuosa* or non-native trees over weedy grassland, and is considered to be in 'completely degraded' condition.

Remnant wetland vegetation occurs in the eastern portion of the site and is generally made up of *Eucalyptus rudis* and *Melaleuca raphiophylla* over sedgeland of *Carex divisa*, open sedgeland of *Baumea articulata* and *Schoenoplectus validus* fringing areas of open water, and grassland of weedy grasses. This area contained an intact overstorey layer over patches of native sedge species along with denser coverage of the introduced sedges and grasses, and is therefore considered to be in 'degraded' condition, as shown in **Figure 6**.

2.4.1.3 Significant Flora

Species of flora acquire Threatened Flora (TF) or Priority Flora (PF) conservation status where populations are restricted geographically or threatened by local processes. The Department of Parks and Wildlife (DPaW) recognises these threats and subsequently applies regulations towards population protection and species conservation. The DPaW enforces regulations under the *Wildlife Conservation Act 1950* (WC Act) to conserve TF species and protect significant populations. PF are described as potentially rare or threatened species and are classified in order of threat.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) promotes the conservation of biodiversity by providing statutory protection for plants at a species level. Some TF species listed under the WC Act are also listed at a Federal level. Section 178 and 179 of the EPBC Act provides for the lists and categories of threatened species under the Act.

Based on a preliminary site inspection by Emerge botanical personnel, no TF or PF species were found within the site. A number of orchid species would not have been detectable at the time of the survey (April 2015), however none are considered highly likely to occur due to the level of historical disturbance and widespread weed invasion which has resulted in the removal of almost all native species.

2.4.1.4 Plant communities

Based on a preliminary site inspection by Emerge botanical personnel in April 2015, the following remnant plant communities (shown in **Figure 7**) were recorded within the site:

- **ErMr:** Woodland to open forest of *Eucalyptus rudis* and *Melaleuca raphiophylla* covered by a vineland of **Ipomoea cairica* over sedgeland of **Carex divisa*, open sedgeland fringing areas of open water of *Baumea articulata* and *Schoenoplectus validus* over grassland of weedy grasses. This plant community is shown in **Plate 1** below.
- Cleared/weed dominated vegetation: scattered planted non-native trees over pasture weeds as shown in **Plate 2**, or wetland areas dominated by weed species such as **Typha orientalis* and **Cortaderia selloana* as shown in **Plate 3**.

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Plate 1: Plant community ErMr in 'degraded' condition in the east of the site.



Plate 2: Scattered planted trees over pasture weeds in 'completely degraded' condition.



Plate 3: Eastern portion of the site containing wetland vegetation dominated by weed species and in 'completely degraded' condition.

2.4.1.5 Threatened and/or Priority Ecological Communities

In Western Australia, Threatened Ecological Communities (TECs) are defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. Generally these can be described as vegetation communities that are assemblages of species that occur together in a particular type of habitat. They are the sum of species within an ecosystem and, as a whole provide many of the processes which support a specific ecosystem. TECs are recognised as specific ecological communities that are rare or under threat.

TECs are not afforded direct statutory protection at a State level but their significance is acknowledged through other State environmental approval processes (i.e. environmental impact assessment pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act)). The State process through DPaW has been identifying and listing TECs since 1994, using a range of definitions to indicate the level of threat to the TEC in question. Specific TECs are also protected under the EPBC Act.

In addition to a listing as a TEC, a community may be listed as a Priority Ecological Community (PEC). This is an ecological community that is under consideration for listing as a TEC, but does not yet meet survey criteria or has not been adequately defined.

Based on species occurrences, soil and landform information, plant community **ErMr** identified within the site is most likely to represent Floristic Community Type (FCT) 11 – *Wet forests and woodlands*. FCT 11 is not listed as either a TEC or PEC.

2.4.2 Bush Forever and conservation reserves

The Government of Western Australia's *Bush Forever Policy* is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of Bush Forever is to protect comprehensive representations of all original ecological communities by targeting a minimum of 10 % of each vegetation complex for protection (Government of Western Australia 2000). Bush Forever Sites are representative of regional ecosystems and habitat and have a key role in the conservation of Perth's biodiversity.

There are no Bush Forever sites within or in close proximity to the site. The closest area of Bush Forever occurs approximately 650 m north-west of the site, as shown in **Figure 8**.

2.4.3 Ecological Linkages

Ecological linkages allow the movement of fauna, flora and genetic material between areas of fragmented remnant habitat. The movement of fauna and the exchange of genetic material between vegetation remnants improve the viability of those remnants by allowing greater access to breeding partners, food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are often continuous or near-continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Molloy *et al.* 2007).

Ecological linkages have been generally identified by the State Government in Bush Forever, Perth's Greenways and the System 6 study (Molloy *et al.* 2007) and have been published by the Perth Biodiversity Project (2017). These identified linkages reflect the on-ground linkages throughout the Perth Metropolitan area. The dataset is employed as a conservation tool aimed to conserve and enhance our regional biological linkages.

The western portion of the site falls within a mapped Ecological linkage (Link 3) as shown in **Figure 8**, which links vegetation values within Bush Forever Sites to the north and further south of the site. The mapped linkage is generally associated with vegetation contained within the Lake Karrinyup Country Club west of the site (see **Figure 8**), and no native vegetation occurs within the portion of the site covered by the mapped Ecological linkage.

2.4.4 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are prescribed under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems.

One ESA occurs within the site, as shown in **Figure 8**.

2.4.5 Terrestrial Fauna

The conservation status of fauna species in Western Australia is assessed under the state administered WC Act. The WC Act utilises a set of schedules and DPaW also produces a list of priority fauna species which while not considered threatened under the WC Act, there is some concern over their long-term survival. As well as those species protected under the WC Act, the Federal government also maintains a list of protected species under the EPBC Act.

The general lack of intact remnant vegetation within the site means there is unlikely to be significant fauna habitat values within the site. Any potential fauna habitat would be limited to the wetland area in

the east of the site (discussed further below) however given the disturbed nature of this area it would not be considered a significant habitat value.

2.5 Hydrology

2.5.1 Groundwater

Groundwater monitoring has been carried out across the site and is documented within the *Local Water Management Strategy* (Hyd2o 2015). The maximum recorded levels were observed in August 2014 and these have been used to calculate the Maximum Groundwater Level (MGL). Depth to groundwater ranges between 6.44 m and 0.55 m Below Ground Level (BGL). Groundwater contours beneath the site have been shown in **Figure 9**.

Information on groundwater from the Department of Water 'Online Water Register' (DoW 2015) indicates that groundwater beneath the site is a multi-layered system comprised of the following:

- Perth – Mirrabooka
- Perth – Superficial Swan
- Perth – Leederville
- Perth – Yarragadee North.

The site is located in the Gwelup groundwater area, within the Gwelup sub-area. The DoW 'Online Water Register' indicates that groundwater resources are fully allocated in the area (DoW 2015). However an existing groundwater licence (Licence No. 164355) covers the site for 26,425kL from the Perth -Superficial Swan aquifer, issued in April 2016 to the proponent (Darron Baynham).

Groundwater monitoring results show that groundwater beneath the site is slightly acidic, with levels falling within the guideline (ANZECC) range (Hyd2o 2015). Mean Total Phosphorus (TP) concentrations and mean Total Nitrogen (TN) concentrations are above guidelines however they are not considered excessively high, and are consistent with the site's historical land use as a market garden (Hyd2o 2015).

Please refer to the LWMS (Hyd2o 2015) for further details.

2.5.2 Surface Water

There are no surface water flow paths within the site, or any external catchments contributing flow into the site (Hyd2o 2015). Wetlands associated with Careniup Swamp are located in the east of the site, as discussed further below. Careniup Swamp forms part of the Water Corporation Main Drainage system, and acts as a compensating basin for stormwater runoff from surrounding residential areas (Hyd2o 2015).

Please refer to the LWMS (Hyd2o 2015) for further details.

2.5.3 Wetlands

Based on DPaW's Geomorphic Wetland series mapping, a large Resource Enhancement Wetland (REW) (UFI 8182) associated with Careniup Swamp extends into the eastern portion of the site (DPaW, 2013), as shown in **Figure 9**. REW areas are recognised as wetlands with moderate natural and human use attributes that can be restored or enhanced.

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Historic disturbances within the site have resulted in the significant alteration of the natural REW features. The majority of the mapped REW UFI No. 8182 within the site now contains the weed **Typha orientalis* surrounding areas of open water. A portion at the eastern end of the site contains relatively intact wetland vegetation (plant community **ErMr**) in 'degraded' condition, as shown in **Figure 6**.

A review of historic aerials for the site indicate that REW UFI No. 8182 was originally vegetated and did not appear to contain areas of open water as present now. A large portion of the mapped REW was excavated in the early 1980s and peat material removed (Cardno BSD 2007). The peat was replaced with fill material that may have included building rubble, and the permanent areas of open water currently on site were established (Cardno BSD 2007). As such, some areas of the REW within the site do not contain their original wetland soils. The south western most portions of the REW no longer support wetland values and have been used for stock grazing. The easternmost portion of the site, containing plant community **ErMr** (see **Figure 7**), does contain original soils and appears to have remained relatively undisturbed throughout this period, with the exception of weed invasion.

Areas of open water in the eastern portion of the site fall partially within the Careniup Swamp 'core area' (shown in **Figure 9**) as defined in the City of Stirling's LPS No. 3 under the Careniup Swamp Special Control Area. This outcome under LPS No. 3 was deemed to not require formal assessment by the Environmental Protection Authority (EPA). Based on recent correspondence from the Office of the EPA (attached in **Appendix B**), where development within the site is consistent with the defined Careniup Swamp 'core area', the proposed alteration to the landform in this portion of the site (and therefore also the mapped REW) does not require further consideration from the EPA. This is discussed further in **Section 3.1**.

2.5.4 Public Drinking Water Sources

Public Drinking Water Source Areas (PDWSAs) are surface water catchments or groundwater recharge areas that have been identified as drinking water sources, and proclaimed as water reserves by the Department of Water (DoW) (DoW 2009), and protected by government legislation. PDWSAs provide the majority of Western Australia's drinking water supplies and can be vulnerable to contamination from a range of land uses and water based activities (DoW 2009) therefore consideration needs to be given to the intended land use and associated activities to ensure that they are appropriate in meeting the water protection quality objectives of the area.

The site is located within a proclaimed Priority 3 (P3) PDWSA, as shown in **Figure 9**. P3 areas are defined where it is necessary to manage the risk of pollution to the water source, and where water supply sources need to co-exist with other existing land uses such as residential, commercial and light industrial development (DoW 2009). P3 areas generally include the requirement for use of best available environmental management practice and connection to deep sewerage. P3 areas are protected in accordance with the objective of risk management, as opposed to avoidance or minimisation (DoW 2009).

As P3 areas allow for urban development, no further consideration is required to support the LSP within the site.

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2.6 Heritage

2.6.1 Indigenous Heritage

Based on a review of the Department of Aboriginal Affairs (DAA) 'Aboriginal Heritage Inquiry System' online database (DAA 2014), there are no registered Indigenous heritage sites within or in close proximity to the site, therefore no further consideration is required within the LSP.

2.6.2 Non-Indigenous Heritage

A desktop search of the City of Stirling's Heritage List (City of Stirling 2014), State Heritage Office database (Heritage Council 2012) and the Australian Heritage Database (Department of Environment 2013) indicated there are no registered heritage sites within or in close proximity to the site.

2.7 Land Use Considerations

2.7.1 Historical land uses and potential contamination

A search of the Department of Environment Regulation's (DER) Contaminated Sites Database and Register (DER, 2013) found there to be no registered contaminated sites within or immediately adjacent to the site.

Based on a review of historic aerial photography the majority of the site was cleared for agricultural purposes (primarily market gardening) prior to 1953. An investigation was undertaken for the site (Cardno BSD 2007) to understand the historic land use history within the site and the likelihood that this history could have resulted in soil and/or groundwater contamination. This investigation indicated that market gardening occurred within the site from prior to 1953 until approximately 1977, and the excavation of peat materials from the eastern portion of the site (within the REW area) occurred from approximately 1965. This area was backfilled with fill material from approximately 1979 to 1995. A recent geotechnical investigation undertaken for the site (CMW Geosciences Pty Ltd 2015) has confirmed that unidentified fill material is located in the east of the site.

2.7.2 Basic Raw Materials

Basic raw materials are described as sand (including silica sand), clay, hard rock, limestone (including metallurgical limestone) and gravel and other construction and road building materials, which are generally important to land development. *State Planning Policy No. 2.4 Basic Raw Materials* provides for the protection of the basic raw materials, with the intention of this policy to ensure these resources can be fully utilised, through appropriate land uses and timeframes for development that may otherwise conflict with this intention.

The site is not located within a designated extraction area or resource location according to mapping provided in *State Planning Policy No. 2.4 Basic Raw Materials* (WAPC, 2000) therefore there are no associated constraints on the timing of the proposed future urban development within the LSP area.

2.7.3 Surrounding land uses

2.7.3.1 Kwinana Freeway

The WAPC's *State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (SPP 5.4)(WAPC 2009) recognises that excessive noise has the potential to affect the health and amenity of a community as a whole, as well as the wellbeing of individuals. The policy

aims to protect people from unreasonable levels of transport noise by establishing a standardised set of criteria to be used in the assessment of development proposals.

The Kwinana Freeway lies approximately 700 m east of the site, and is separated from the site by existing urban development. The proposed sensitive development within the site is not, therefore, considered to be in the vicinity of the noise source (Kwinana Freeway), as defined by SPP 5.4, and no further acoustic considerations are required.

2.8 Natural Hazards

2.8.1 Flooding

Wetlands associated with Careniup Swamp located in the east of the site form part of the Water Corporation Main Drainage system, and act as a compensating basin for stormwater runoff from surrounding residential areas (Hyd2o 2015). Detailed site specific flood modelling was undertaken as part of the LWMS (Hyd2o 2015) prepared for the site, in order to determine the management requirements for stormwater within the LSP design. Flood storage areas will be utilised to detain and infiltrate runoff from small rainfall events (1 in 1 year ARI event), while larger rainfall events will overflow into Careniup Swamp in the east of the site via an overland spillway (Hyd2o 2015).

Please refer to the LWMS (Hyd2o 2015) for further details.

2.8.2 Bushfire Hazard

The site is currently identified as a "Bushfire Prone Area" under the state-wide *Map of Bush Fire Prone Areas* released by the Office of Bushfire Risk Management (OBRM 2016). The identification of Bushfire Prone Areas within any portion of the site requires further assessment of the bushfire hazard implications on proposed development to be undertaken in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas* (the Guidelines) (WAPC and DFES 2017).

A Bushfire Management Plan (BMP) has been prepared for the site by Bushfire Safety Consulting Pty Ltd and Emerge Associates (2017). The BMP assesses the potential risk to future properties within the site and aims to put management measures in place to reduce the risk of harm to people and property.

Areas of vegetation within and surrounding the site have been assessed and classified to have the potential to pose a moderate to extreme fire hazard to the development. The significant bushfire hazard features of the site include vegetation within the Lake Karrinyup Country Club golf course to the west (west of North Beach Road), and vegetation in the east of the site, within the Careniup Swamp wetlands system. The management of bushfire hazards is discussed further in **Section 4**.

3 Local Structure Plan and Planning Approval Framework

3.1 Historical Planning and Environmental Assessment Context

In 1994, the City of Stirling referred their 'District Planning Scheme No. 2 Amendment 209 – rezoning' to the Environmental Protection Authority (EPA). This amendment proposed a 'core area' of the existing Careniup Swamp that would be retained for conservation and rehabilitation purposes. This core area is shown in **Figure 9**. The EPA found that the proposed amendment did not warrant formal assessment as the overall environmental impact would not be significant (as outlined in correspondence from the Office of the EPA (letter dated 27 December 2012) attached in **Appendix B**). The core area for Careniup Swamp was subsequently adopted into the City of Stirling's LPS No. 3 as the Careniup Swamp Special Control Area, and has guided surrounding urban development in the area.

3.2 Local Structure Plan

A Local Structure Plan has been prepared for the site by Dynamic Planning and Developments (2015). A revised Local Structure Plan was prepared by Rowe Group in March 2017 to address comments made by the WAPC. The revised LSP is provided in **Appendix A**. The LSP design incorporates the inputs from a multi-disciplinary project team, and the outcomes from various technical studies. The LSP area includes a total area of approximately 3.4 ha and the proposed land uses include:

- Residential lots.
- Existing commercial business.
- Road reserves.
- Public open space, including retention of wetland values.

This EAMS has been prepared to provide a summary of the environmental values and attributes found within the site and specifically address the proposed development of the site as defined by the LSP. It is the key supporting environmental document for the LSP process, facilitating the consideration of any environmental issues by the various state agencies and the City of Stirling.

The EAMS is consistent with the EPA's current *Guidance Statement No. 33 Environmental Guidance for Planning and Development* (EPA 2008) and the WAPC's *Structure Plan Preparation Guidelines* (WAPC 2012) and includes:

- Identification of significant environmental features.
- Management strategies specific to each environmental feature within the LSP area.
- Opportunities for enhancement of the environmental features and issues to address at later stages of development.

3.3 Future Planning Approval Process

The LSP will be submitted to the City of Stirling for consideration, with final approval to be given by the City of Stirling and Western Australian Planning Commission (WAPC). Following LSP approval, subdivision and development of areas generally in accordance with the LSP will be progressed.

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It is usual for this process to involve the imposition of subdivision conditions, in accordance with the WAPC's *Model Subdivision Conditions Schedule May 2016* (WAPC 2016), and these generally cover the following relevant areas:

- Amenity.
- Buildings and use.
- Drainage and site works.
- Electricity and gas pipelines.
- Environmental conditions.
- Fire and emergency.
- Heritage (indigenous, state, local, etc.).
- Lot design.
- Reserves.
- Transport roads and access.
- Water and sewers.

This condition framework provides a future environmental management framework for the site and is discussed further in **Section 4**.

3.4 Relevant Environmental Factors and Considerations

Table 2 lists the environmental factors that have been investigated for the site, and summarises those that require further specific attention in **Section 4**.

Table 2: Relevant environmental factors and considerations for LSP

ENVIRONMENTAL FACTOR	RELEVANT CONSIDERATIONS
Climate	No issues posed and therefore no further consideration is required.
Topography	No issues posed and therefore no further consideration is required.
Geology	No issues posed and therefore no further consideration is required.
Landform and soils	No issues posed and therefore no further consideration is required.
Acid Sulfate Soils	There is a "high to moderate risk" of ASS occurring within 3 m of the natural soil surface in the east of the site. This may present management issues when excavation is required for services (e.g. sewers) or dewatering is required. This is addressed further in Section 4 .
Flora and Vegetation	Wetland vegetation is proposed to be retained within public open space in the eastern portion of the site. This is discussed further in Section 4 .
Bush Forever	There are no Bush Forever sites located within or in the vicinity of the site, therefore no further consideration is required.
Ecological Linkages	One ecological linkage is present in the western portion of the site, however no remnant vegetation is contained within the site within this area so no further consideration is required
Environmentally Sensitive Areas (ESAs)	No ESA issues posed and therefore no further consideration is required.
Terrestrial Fauna	As remnant vegetation within the site is limited, and those areas remaining are in "Completely Degraded" to "Degraded" condition. Any fauna habitat values are limited to vegetation within the Careniup Swamp wetland in the eastern extent of the site. This is addressed further in Section 4 .

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ENVIRONMENTAL FACTOR	RELEVANT CONSIDERATIONS
Groundwater	Pre-development groundwater levels and quality will need to be maintained post-development. This is addressed further in Section 4 .
Surface Water	No surface water issues posed, therefore no further consideration is required.
Wetlands	A REW associated with Careniup Swamp occurs in the east of the site. Development complies with the 'core area' specified within the City of Stirling's LPS No. 3 Careniup Swamp Special Control Area. This is discussed further in Section 4 .
Public Drinking Water Sources Areas (PDWSAs)	The site is located within a Priority 3 PDWSA. This poses no issues to the LSP therefore no further consideration is required.
Indigenous Heritage	There are no Indigenous heritage values within or in close proximity to the site therefore no further consideration is required.
Non-Indigenous Heritage	There are no non-Indigenous heritage values within or in close proximity to the site therefore no further consideration is required.
Historic Land Uses	Historic land uses within the site may pose potential contamination considerations. This is addressed further in Section 4 .
Surrounding Land Uses	There are no issues posed by surrounding land uses, therefore no further consideration is required.
Bushfire Hazard	Classified vegetation within and surrounding the site has the potential to pose an extreme bushfire hazard to development within the site. This is addressed further in Section 4 .

4 Environmental Assessment and Management

This section discusses in detail the spatial response of the LSP to the environmental values and attributes associated with the site, and also outlines future environmental management considerations that will be required for relevant environmental factors as part of future subdivision and development within the LSP area. This section discusses only those environmental values and attributes that required specific consideration based on their presence within the site, and/or applicable legislation and policy requirements, which was addressed in **Section 3** and summarised in **Table 2**.

4.1 Landform and Soils - Acid Sulfate Soils

4.1.1 Policy framework and management objective

The Department of Environment Regulation (DER), through the WAPC, ensures ASS are adequately managed during the subdivision process.

The objective of the DER's ASS policy framework is to manage ASS appropriately to prevent the release of metals, nutrients and acidity into the soil and groundwater system that may adversely affect the natural and built environment and human health.

4.1.2 LSP considerations for Acid Sulfate Soils

ASS management does not require any spatial consideration within the LSP.

4.1.3 Future Acid Sulfate Soil management requirements

The WAPC includes a standard condition on all subdivision applications (model subdivision condition EN8, WAPC 2016) which states:

An acid sulphate soils self-assessment form and, if required as a result of the self-assessment an acid sulphate soils report and an acid sulphate soils management plan shall be submitted to and approved by the Department of Environment and Conservation before any subdivision works are commenced. Where an acid sulphate soils management plan is required to be submitted, all subdivision works shall be carried out in accordance with the approved management plan (Department of Environment and Conservation) (now DER).

For the portion of the site with an ASS risk rating of "high to moderate risk", ASS investigations and management considerations for the site will be required at subdivision for dewatering and the installation of deep sewer facilities. The area of high to moderate risk generally matches up with the mapped REW in the east of the site, and particular consideration should be given to where development is proposed in this area.

4.1.4 Predicted environmental outcomes

Any future ASS considerations will be identified and managed during the subdivision process according to DER's standards and policy framework.

4.2 Biodiversity and Natural Assets – Flora and Vegetation

4.2.1 Policy framework and management objective

The Environmental Protection Authority's *Guidance Statement No. 33 Environmental Guidance for Planning and Development* (EPA 2008) states their broad objective for flora and vegetation biodiversity conservation as: "to maintain the abundance, diversity, geographic distribution and productivity of flora at the species and ecosystem levels through the avoidance or management of adverse impacts and through improvement in knowledge."

4.2.2 LSP considerations for flora and vegetation

While remnant vegetation is limited within the site due to historic land uses, spatial consideration has been provided within the LSP through the provision for the retention of wetland vegetation within the Careniup Swamp core area in the east of the site, within proposed public open space. The location of the development boundary was determined through the implementation of the 'core area' as specified in the City of Stirling's LPS No. 3 Careniup Swamp Special Control Area.

4.2.3 Future flora and vegetation management requirements

Any future landscaping of public open space and road reserves, or any rehabilitation works within Careniup Swamp in the east of the site will involve the use of native endemic flora and vegetation species representative of the diversity of species found in the surrounding area.

4.2.4 Predicted environmental outcomes

Remnant vegetation is to be retained within the Careniup Swamp core area in the east of the site. This, along with the planting and management (weed control) of public open space areas and road reserves with flora species native to the local area, will address the EPA's policy objective.

4.3 Biodiversity and Natural Assets – Terrestrial Fauna

4.3.1 Policy framework and management objective

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal mechanism for the Commonwealth government to play a role in the protection and management of nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). Under the EPBC Act, a person must not take an action that has, will have, or is likely to have a significant impact on any MNES without approval from the Australian Government Environment Minister.

At the State level, the EPA's *Environmental Assessment Guideline No. 8 Environmental factors and objectives* states their objective for terrestrial fauna conservation in the development process, which is: "to maintain representation, diversity, viability and ecological function at the species, population and assemblage level."

4.3.2 LSP considerations for terrestrial fauna

The majority of the site has been historically cleared for agricultural purposes and as such, limited fauna habitat values remain. Potentially high value fauna habitat is located within the Lake Karrinyup Country Club west of the site, and reserved within Bush Forever sites to the north, west and south of the site.

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Spatial consideration has been provided through the strategic placement of public open space to retain portions of the existing wetland vegetation in the east of the site, associated with the Careniup Swamp core area as outlined in the City of Stirling's LPS No. 3 Careniup Swamp Special Control Area. This vegetation will provide opportunistic habitat for mobile fauna species.

4.3.3 Future terrestrial fauna management requirements

There will be no future management requirements for terrestrial fauna and fauna habitat within the site.

4.3.4 Predicted environmental outcomes

Terrestrial fauna habitat values and linkages will be maintained through vegetation to be retained within Careniup Swamp core area within and to the east of the site, and through vegetation west of the site retained within the adjacent golf course.

4.4 Hydrology - Groundwater

4.4.1 Policy framework and management objective

The *State Water Strategy* (Government of Western Australia 2003) and *Better Urban Water Management* (WAPC 2008) endorse the promotion of integrated water cycle management and application of WSUD principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies.

The key principles of integrated water cycle management include:

- Considering all water sources, including wastewater, stormwater and groundwater.
- Integrating water and land use planning.
- Allocating and using water sustainably and equitably.
- Integrating water use with natural water processes.
- Adopting a whole of catchment integration of natural resource use and management.

The EPA's *Environmental Assessment Guideline No. 8 Environmental factors and objectives* (EPA 2013) outlines the following key objectives for the management of groundwater:

- To maintain the hydrological regimes of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.
- To maintain the quality of groundwater, sediment and biota so that the environmental values, both ecological and social, are protected.

State Planning Policy 2.9 Water Resources (WAPC 2006) outlines the following key policy objectives:

- Protect, conserve and enhance water resources that are identified as having significant economic, social, cultural and/or environmental values.
- Assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources.
- Promote and assist in the management and sustainable use of water resources.

ENVIRONMENTAL ASSESSMENT AND MANAGEMENT STRATEGY
455 (LOT 2) NORTH BEACH ROAD LOCAL STRUCTURE PLAN**4.4.2 LSP considerations for groundwater**

The LWMS prepared for the site (Hyd2o 2015) provides a framework for the future delivery of a best practice approach to integrated water cycle management utilising Water Sensitive Urban Design (WSUD) objectives, including detailed management approaches for:

- Potable water consumption
- Flood mitigation
- Stormwater quality management
- Groundwater management.

Minimum separation between lots and groundwater are to be achieved using a proposed combination of sand fill and subsoil drainage systems to protect against a rise in post development groundwater levels (Hyd2o 2015). Subsoils drainage is likely to be confined to the eastern portion of the site, with the exact extent to be identified and detailed as part of future development stages.

Groundwater quality will be managed by managing nutrient inputs within surface runoff (consistent with those proposed for stormwater quality) and through treatment of groundwater prior to entering the subsoil drainage network.

4.4.3 Future groundwater management requirements

An Urban Water Management Plan (UWMP) will be required for each stage of subdivision within the site, in order to address WAPC's standard model subdivision condition D2 (WAPC 2016) which states:

Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water, consistent with any approved Local Water Management Strategy. (Local Government).

In order for lots and drainage basins to clear the controlled groundwater level, significant amounts of imported fill will be required across the site. Model subdivision condition D3 (WAPC 2016) requires the submission and approval of engineering drawings and specifications regarding the filling and/or draining of the land, including ensuring that stormwater is contained on-site, or appropriately treated and connected to the local drainage system. Such engineering drawings and specifications will be in accordance with an approved UWMP. The requirement for fill within the site will also address model subdivision condition D4 (WAPC 2016) which states:

The land being filled, stabilized, drained and/or graded as required to ensure that:

- a) Lots can accommodate their intended development*
- b) Finished ground levels at the boundaries of the lot(s) the subject of this approval match or otherwise coordinate with the existing and/or proposed finished ground levels of the land abutting; and*
- c) Stormwater is contained on-site, or appropriately treated and connected to the local drainage system. (Local Government)*

4.4.4 Predicted environmental outcomes

The LWMS provides the framework for the LSP to manage groundwater levels and quality in a contemporary best-practice approach utilising WSUD objectives, and in accordance with the WAPC

and EPA guidelines and policy frameworks. The preparation of a UWMP to satisfy subdivision approval will provide design details that will ensure the sustainable use of groundwater resources.

4.5 Hydrology – Wetlands

4.5.1 Policy framework and management objective

State Planning Policy 2.9 Water Resources (WAPC 2006) outlines the following key policy objectives for the management of wetlands:

- Protect, conserve and enhance water resources that are identified as having significant economic, social, cultural and/or environmental values;
- Assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources; and
- Promote and assist in the management and sustainable use of water resources.

Of particular relevance for the site, key policy measures for REW outlined in *State Planning Policy 2.9* include:

- Manage, conserve and, where possible, restore the environmental attributes, functions and values of resource enhancement wetlands.
- Ensure use of best management practices in the development, consistent with the principles of total water cycle management.
- Ensure adequate and appropriate buffering of wetlands, waterways and estuaries to maintain or enhance the environmental attributes, functions and values of the water resource and minimise the impact of nearby land uses, both existing and future.

4.5.2 LSP considerations for wetlands

Careniup Swamp is identified under the City of Stirling's LPS No. 3 as a 'Special Control Area', which identifies a 'core area' of the wetland to be preserved for rehabilitation and conservation purposes. This core area is shown spatially in **Figure 9**. Surrounding urban development has remained consistent with this endorsed 'core area', retaining wetland values within the identified core area, and providing an appropriate public open space interface between the wetland values and residential development.

Recent correspondence from the Office of the EPA (OEPA), attached in **Appendix B** regarding potential urban development within the site indicates support for development which is consistent with the Careniup Swamp ODP and Rehabilitation Plan (which specified the wetland's core area), which was endorsed by the then Department of Environmental Protection in 1994.

The LSP provides a framework for development over a portion of the mapped REW without encroaching on the specified Careniup Swamp core area, which is to be retained within public open space. A road and POS interface is proposed between the wetland core area and residential development, as shown in **Figure 9**. This approach is consistent with surrounding urban developments within the Careniup Swamp Special Control Area.

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4.5.3 Future wetland management requirements

A Wetland Management Plan will be prepared for Careniup Swamp in the east of the site as per the WAPC standard model subdivision condition EN1 (WAPC 2016) in order to ensure the protection and management of wetland values within the site. This Wetland Management Plan will outline details on items including any planting requirements, weed control, ongoing management and maintenance, handover, etc. and will be based on further consultation with the City of Stirling.

4.5.4 Predicted environmental outcomes

REW values within the site will be retained within the core area of Careniup Swamp SCA in the east of the site. Future weed management and planting regimes within the core area will be negotiated with the City of Stirling, and will contribute to the protection, conservation and enhancement of wetland values, as per the management objective outlined in *State Planning Policy 2.9*.

4.6 Land use considerations – potential contamination**4.6.1 Policy framework and management objective**

Management of potential site contamination is addressed under the *Contaminated Sites Act 2003* which aims to protect human health, the environment and environmental values by providing for the identification, recording, management and remediation of contaminated sites in the State.

The provisions of the *Contaminated Sites Act 2003*, can be triggered during the land use planning process where a site may have been used for a potentially contaminating activity and the suitability of the site for the intended land use is unknown. The imposition of a condition requiring the assessment of contamination at a site as part of a subdivision approval is the most common trigger for the assessment of contamination during redevelopment, and this can occur as a result of an existing classification pursuant to the *Contaminated Sites Act 2003*, or a known or suspecting contaminating land use.

4.6.2 LSP considerations for potential contamination

Based on the information at hand, there does not appear to be any significant contamination related impediments to the proposed land uses that cannot be addressed during subdivision and the associated works with a standard residential development. No spatial consideration is required in the LSP.

4.6.3 Future management requirements for potential contamination

Given the historic land uses within the site, further detailed site investigations may be required as part of future subdivision stages in order to accurately determine any risk to human and environmental health associated with historic land uses within the site. If these investigations are not undertaken prior to subdivision, this may result in a condition on subdivision approval as per model subdivision condition EN9 (WAPC 2016) which states:

- a) *Prior to commencement of subdivision works, investigation for soil and groundwater contamination is to be carried out to determine if remediation is required.*
- b) *If required, remediation, including validation of remediation, of any contamination identified shall be completed prior to the issuing of titles to the satisfaction of the Western Australian*

Planning Commission on advice from the Department of Environment and Conservation, to ensure that the lots created are suitable for the proposed use.

4.6.4 Predicted environmental outcomes

Subdivision and development within the site will proceed once any identified risk (if any) to human and environmental health is identified and (if found) removed or reduced to an acceptable level, in accordance with the *Planning and Development Act 2005* and the *Contaminated Sites Act 2003*.

4.7 Natural Hazards – Bushfire Management

4.7.1 Policy Framework and Management Objective

The WAPC's *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) outlines the expectations for addressing bushfire risk within the planning framework, with the intent of supporting the preservation of life and reduce the impact of bushfire on property and infrastructure. SPP 3.7 has been considered as part of the fire management for the site. The *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017) have been prepared to assist in the implementation of SPP 3.7. Where an area is identified as bushfire prone within the *Map of Bushfire Prone Areas* produced by the Office of Bushfire Risk management (OBRM) (2016) further consideration of bushfire hazard and risk is required.

A Bushfire Management Plan (BMP) has been prepared for the site by Emerge Associates and Bushfire Safety Consulting Pty Ltd (2017), in line with SPP 3.7 (WAPC 2015) and the Guidelines (WAPC and DFES 2017). This BMP aims to address bushfire management issues within the Structure Plan and, through this reduce the occurrence of and minimise the impact of bushfires within and surrounding the site, thereby reducing the threat to life, property and the environment.

Vegetation within and surrounding the site has been classified in accordance with AS 3959 (Standards Australia, 2009). Vegetation that is to be permanently retained surrounding the site will pose permanent bushfire hazard considerations. In the same way, vegetation that is to be cleared for future urban purposes in the short to medium term will pose only temporary bushfire management considerations.

4.7.2 LSP Considerations for Bushfire Management

As outlined in the BMP (Emerge Associates and Bushfire Safety Consulting 2017), permanent bushfire hazards posed for the site are associated with woodland vegetation west of the site (west of North Lake Road), and wetland vegetation within the Careniup Swamp in the east of the site.

The LSP has accommodated these permanent bushfire hazards through the placement of roads or managed parkland/POS areas to provide an appropriate setback or interface with development. Proposed lots in the western portion of the site will require an internal lot setback (Asset Protection Zone) to ensure that future dwellings are not exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29). Please refer to the BMP (Emerge Associates and Bushfire Safety Consulting 2017) for further details.

4.7.3 Future Bushfire Management Requirements

As outlined in the BMP, development within 100 m of classified vegetation will require further detailed bushfire risk assessment (in the form of a detailed BAL assessment) to be completed and certified

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prior to dwelling construction. This BAL assessment will inform the requirement for increased construction standards for proposed dwellings within the site, in accordance with AS 3959, which will then be implemented through the building licence process. An indicative BAL assessment has been completed as part of the BMP and indicates that no future dwellings will be subject to a BAL rating higher than BAL-29.

Please refer to the BMP (Emerge Associates and Bushfire Safety Consulting 2017) for further details.

4.7.4 Predicted Environmental Outcomes

By utilising the BMP at this early stage of planning process, the LSP has been able to incorporate bushfire hazard management considerations into the design of the development, ensuring that, if there is a bushfire within or near the site, the threat to residents, property and emergency response personnel will be reduced.

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5 Summary and Conclusions

Emerge Associates was engaged by the proponent to provide a suite of environmental services to support the preparation of a LSP for the site. This has included numerous investigations to identify and assess the environmental attributes and values within the site.

The environmental attributes and values identified within the site have been outlined in **Section 2** and include:

- The site has been historically cleared for agricultural purposes therefore remnant vegetation is limited to paddock trees and wetlands in the east of the site associated with Careniup Swamp.
- A REW covers the east of the site, associated with Careniup Swamp. This area has been historically disturbed, and contains a mixture of remnant wetland values and artificial water bodies.
- An ESA occurs in the east of the site associated with Careniup Swamp.
- Based on site inspections undertaken by Emerge ecologists, vegetation within the site is generally in “Completely Degraded” or “Degraded” condition (based upon the Bush Forever Condition Scale).
- No Threatened Flora (TF), Priority Flora (PF), Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) were recorded within the site.
- The site occurs within a Priority 3 PDWSA.
- Historic land uses within the site do pose potential contamination considerations, however based on the information at hand, there does not appear to be any significant contamination related impediments to the proposed land uses that cannot be addressed during subdivision and the associated works with a standard residential development.
- The site is currently used for livestock grazing activities, and supports a veterinary clinic and a residential dwelling. However, it is located in a broader local area that is targeted for and suited to residential infill development.
- Permanently retained vegetation within and surrounding the site may present a bushfire hazard risk to development.

The LSP has responded to the environmental values and attributes of the site and outlines an environmental management framework that will be progressed through the relevant stages of the planning process and development of the site.

Specifically the LSP has responded to the environmental values and attributes of the site through:

- Retention of vegetation within the Careniup Swamp core area in the east of the site
- Preparation of a Local Water Management Strategy (Hyd2o 2015) in accordance with Better Urban Water Management (BUWM) (WAPC 2010).
- Preparation of a Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2017) and placement of a road reserve and managed public open space to interface with the wetland core area to accommodate an APZ required to manage bushfire threats resulting from retained vegetation within the core area.

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Future environmental management requirements can be addressed through future planning approvals, and specifically through subdivision conditions likely to be required for the development, including:

- Preparation of an ASS self-assessment in accordance with model subdivision condition EN8 (WAPC 2016) and potentially undertaking further detailed ASS investigations and management plans depending on the subdivision construction methodology.
- Preparation of a Wetland Management Plan in accordance with model subdivision condition EN1 (WAPC 2016).
- Preparation of an Urban Water Management Plan in accordance with model subdivision condition D2 (WAPC 2016).
- Addressing any contamination within the site as per model subdivision condition EN9 (WAPC 2016).
- A detailed Bushfire Attack Level (BAL) assessment for proposed buildings within declared bushfire prone areas, as outlined in the Bushfire Management Plan (Emerge Associates and Bushfire Safety Consulting 2017) for the site, as part of the subdivision or building approval process for residential dwellings.
- Place a notification on the titles of those proposed lots that are subject to bushfire risk, as per model subdivision condition F8 (WAPC 2016).

These mechanisms ensure that the future development of the site will not significantly impact on the environmental values and attributes of the site and that an appropriate planning and development framework exists to respond to, and manage, the environment.

6 References

Beard, J. S., 1990, *Plant life of Western Australia*, Kangaroo Press, Perth.

Bureau of Meteorology, 2014, Climate Data Online. Available from:
<http://www.bom.gov.au/climate/data/> (Accessed September 2014).

Cardno BSD, 2007, *Potential Site Contamination, Acid Sulfate Soils and Environmental Planning Constraints*, Report prepared for Christie Whyte Moore.

Churchward, H. M. and McArthur, W. M., 1980, *Landforms and Soils of the Darling System*, Atlas of Natural Resources, Darling System, Western Australia, Department of Conservation and Environment, Perth.

CMW Geosciences Pty Ltd, 2015, *Geotechnical Investigation Report*, Unpublished report prepared for Darron Baynham.

Department of Aboriginal Affairs, 2014, *Aboriginal Heritage Inquiry System*, Available from:
<http://www.dia.wa.gov.au/AHIS/default.aspx> (Accessed September 2014).

Department of Environment, 2006, *Draft Identification and Investigation of Acid Sulfate Soils*, Department of Environment, Western Australia.

Department of Environment and Conservation (DEC), 2012, *Geomorphic Wetlands Swan Coastal Plain dataset*, Available from: <http://www.dec.wa.gov.au/management-and-protection/wetlands/wetlands-mapping/geomorphic-wetlands-swan-coastal-plain-dataset.html> (Accessed September 2014).

Department of Environment and Conservation (DEC), 2013, A visual guide to the Interim Biogeographic Regionalisation for Australia (IBRA) in WA, Available from:
<http://florabase.dec.wa.gov.au/help/ibra/#map> (Accessed September 2014).

Department of Environment Regulation, 2014, *Contaminated Sites Database*, Available from:
<https://secure.dec.wa.gov.au/idelve/css/> (Accessed September 2014).

Department of Water, 2009, *Water Quality Protection Note 36: Protecting public drinking water source areas*, Available from: <http://www.water.wa.gov.au/firstdowPublic/DocViewer?id=37812> (Accessed March 2017).

Department of Water, 2014, *Water Register*, Available from:
<http://www.water.wa.gov.au/ags/WaterRegister/> (Accessed September 2014).

Department of Water, 2014, *Perth Groundwater Atlas*, Available from:
<http://www.water.wa.gov.au/idelve/gwa/> (Accessed March 2017).

EPA (2004). Guidance Statement No. 51. Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia. Environmental Protection Authority. Perth, Environmental Protection Authority

Emerge Associates and Bushfire Safety Consulting, 2017, Bushfire Management Plan prepared for 455 (lot 2) North Beach Road, Gwelup

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Environmental Protection Authority (EPA) 2006a, *Guidance Statement No. 10. Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region*, Environmental Protection Authority, Perth.
http://www.epa.wa.gov.au/Policies_guidelines/EAGs/guidance/Pages/ReportPages.aspx?cat=Guidance%20Statements&url=Policies_guidelines/EAGs/guidance

Environmental Protection Authority (EPA) 2006, *Environmental Offsets Position Statement No. 9*, Environmental Protection Authority, Perth. http://edit.epa.wa.gov.au/EPADocLib/1863_PS9.pdf

FIT Landscape, 2015, *Landscape Master Plan*, Unpublished report prepared for Darron Baynham.

Gibson, N., Keighery, B., Keighery, G., Burbidge, A. and Lyons, M. 1994, *A Floristic survey of the southern Swan Coastal Plain*, Department of Conservation and Land Management and the Conservation Council of Western Australia

Government of Western Australia 2000a, *Bush Forever - Volume 2: Directory of Bush Forever Sites*, Western Australian Planning Commission, Perth.

Government of Western Australia, 2000b, *Bush Forever – Volume 1: Policies, Principles and Processes*, Western Australian Planning Commission, Perth.

Gozzard JR, 1983 *Perth Metropolitan Region 1: 50,000 Environmental Geology Series, Perth (Fremantle Part Sheets 2033 I and 2033 IV)*, Geological Survey of Western Australia.

Heddle, E. M., Loneragan, O. W. and Havel, J. J., 1980, *Darling Systems – Vegetation Complexes*, In: *Atlas of Natural Resources Darling System, Western Australia*, Department of Conservation and Environment, Perth.

Hyd2o, 2015, *Local Water Management Strategy*. Unpublished report prepared for Dynamic Development Solutions.

Miles, C. 2001, *NSW Murray Catchment Biodiversity Action Plan*, Nature Conservation Working Group Inc, Albury, New South Wales

Perth Biodiversity Project (PBP) 2013, *2013 Native Vegetation extent by Vegetation complexes on the Swan Coastal Plain south of Moore River* Western Australian Local Government Association, Perth.
<http://pbp.walga.asn.au/Portals/1/Templates/docs/SCP%202013%20remnant%20veg.pdf>

Seddon, G., 2004, *Sense of Place: A Response to an Environment: The Swan Coastal Plain*, Western Australia, Melbourne

Standards Australia 2009, *AS 3959-2009 Construction of buildings in bushfire-prone areas*, Sydney

Thackway, R. and Cresswell, I. D., (Eds) 1995, *An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves*, Version 4.0. Australian Nature Conservancy Agency, Canberra

Western Australian Local Government Association & Perth Biodiversity Project (2004) *Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region*, Report authors: Del Marco A, Taylor R, Clarke K, Savage K, Cullity J & Miles C, Perth.

Western Australian Planning Commission (WAPC), 2010, *Better Urban Water Management*, Western Australian Planning Commission, Perth

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Western Australian Planning Commission (WAPC), 2012, *Structure plan preparation guidelines*, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC), 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth

Western Australian Planning Commission (WAPC), 2016, *Model Subdivision Conditions Schedule (May 2016)*, Western Australian Planning Commission, Perth

Western Australian Planning Commission (WAPC) 2015a, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth, Perth.

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.1*, Western Australian Planning Commission, Perth

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FIGURES



Figure 1: Site Plan

Figure 2: Proposed Local Structure Plan

Figure 3: Topography

Figure 4: Landforms

Figure 5: Acid Sulfate Soils

Figure 6: Vegetation condition

Figure 7: Plant communities

Figure 8: Bush Forever, ESAs and Ecological Linkages

Figure 9: Hydrology and Geomorphic Wetlands



Plan Number: EP15-02 (01)-F08a	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:3,000@A4

Legend	Site boundary
	Cadastral boundary



Figure 1: Site Plan

Project: Environmental Assessment and Management Strategy
455 (Lot 2) North Beach Road, Gwelup

Client: Damon Beynham



Plan Number: EP15-021(01)-F09a	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:2,000@A4

	Site boundary		Proposed LSP		Residential
	Cadastral boundary		Road		Public open space



Figure 2: Proposed Local Structure Plan

Project: Environmental Assessment and Management Strategy
455 (Lot 2) North Beach Road, Gwelup

Client: Damon Boynham



Plan Number: EP15-021(01)-F11b	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:2,000@A4
0 40 80 Metres	

	Legend
	Site boundary
	Cadastral boundary
	Topographic contour (mAHD)



Figure 3: Topography
Project: Environmental Assessment and Management Strategy 455 (Lot 2) North Beach Road, Gwelup
Client: Damon Beynham



Plan Number: EP15-021(01)-F12b	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:2,500@A4
0 30 60 Meters	

Legend

	Site boundary		Soil association
	Cadastral boundary		Herdman
			Karrakatta



Figure 4: Landforms

Project: Environmental Assessment and Management Strategy
455 (Lot 2) North Beach Road, Gwelup

Client: Damon Beynham



Figure 5: Acid Sulfate Soils
 Project: Environmental Assessment and Management Strategy
 455 (Lot 2) North Beach Road, Gwelup
 Client: Damon Beynham



Legend

- Site boundary
- Cadastrial boundary

ASS Risk Category

- High to moderate risk
- Moderate to low risk

Plan Number: EP15-021(01)-F13b	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:2,500@A4
0 30 60 Metres	





Legend

- Site boundary
- Cadastral boundary
- Open water

Vegetation Condition

- Completely degraded
- Degraded
- Good
- Very good
- Excellent
- Pristine

Plan Number: EP15-021(01)-F06b	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:1,500@A4
0 20 40 Meters	



Figure 6: Vegetation Condition

Project: Environmental Assessment and Management Strategy
455 (Lot 2) North Beach Road Local Structure Plan

Client: Damon Boynham



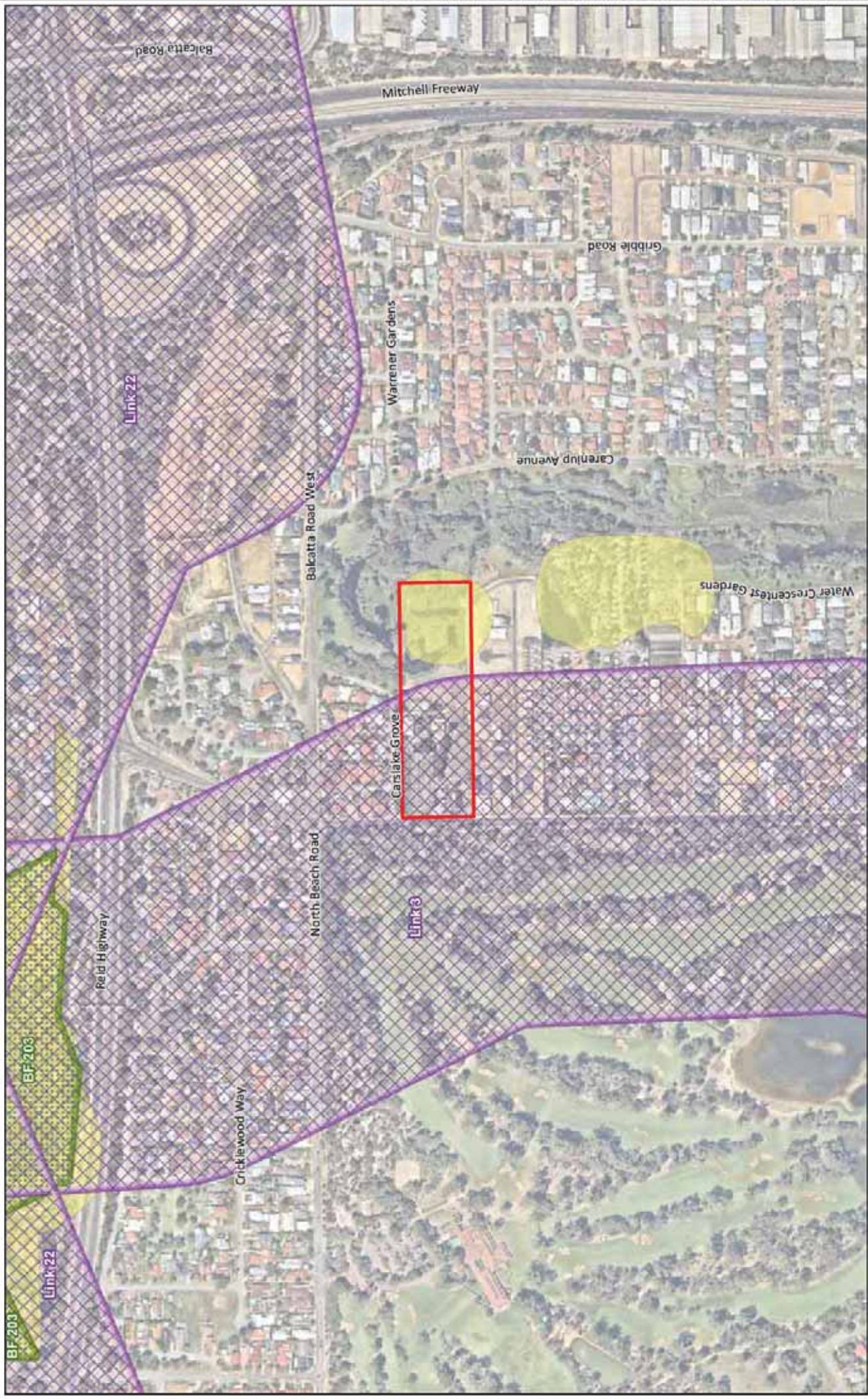
Plan Number: EP15-021(01)-F07b	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:1,500@A4
0 20 40 Meters	



Figure 7: Plant Communities

Project: Environmental Assessment and Management Strategy
455 (Lot 2) North Beach Road Local Structure Plan

Client: Damon Boynham



Plan Number: EP15-021(01)-F14b	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:7,000@A4

	Site boundary
	Ecological linkage (PBP 2007)
	Bush Forever (DoP 2007)
	ESA (DER 2017)



Figure 8: Bush Forever, ESAs and Ecological Linkages

Project: Environmental Assessment and Management Strategy
455 (Lot 2) North Beach Road, Gwelup

Client: Damon Beynham



Legend
Site boundary
Groundwater contours (mAWD)
Carenlup Swamp care area
Public drinking water source areas
Priority three
Geomorphic wetlands
Conservation
Resource Enhancement
Multiple Use
Not Assessed
Not Applicable

Plan Number: EP15-021(01)-F15b	
Drawn: DCM	Date: 09/03/2017
Approved: JL	Date: 17/03/2017
Checked: DCM	Scale: 1:7,000@A4
	



Figure 9: Hydrology and Geomorphic Wetlands

Project: Environmental Assessment and Management Strategy
455 (Lot 2) North Beach Road, Gwelup

Client: Damon Boynham

APPENDIX A



LOCAL STRUCTURE PLAN (ROWE GROUP 2017)

Proposed Subdivision

Lot 2 (No. 455) North Beach Road, Gwelup



LEGEND	
	Subject Site
7	Existing Lot Numbers
	Existing Boundaries
7	Proposed Lot Numbers
	Proposed Boundaries
	Existing Building (To Be Retained)
	Existing Building (To Be Demolished)
	Public Open Space
	Road Pavement
Lot Summary	
No. of Lots	64
Total Area of Lots	2,088.7m ²
Average Area of Lots	32.637m ²
Minimum Lot Area	25.03m ²
Maximum Lot Area	1,671.83m ²

APPENDIX B



LETTER OF ADVICE FROM THE EPA (DATED 27 DECEMBER 2012)



Ms Emma Jeans
Town Planner
Dynamic Planning and Developments
PO Box 1616
SUBIACO WA 6904

Your Ref: 226
Our Ref: A575068:OEPA2012/000700
Enquiries: Amy Sgherza, 6467 5424
Email: amy.sgherza@epa.wa.gov.au

Dear Madam

LOT 2 (NO. 455) NORTH BEACH ROAD, GWELUP

Thank you for your letter of 26 November 2012 in relation to a structure planning and subdivision process for Lot 2 (No. 455) North Beach Road, Gwelup (the site).

The Office of the Environmental Protection Authority (EPA) provides the following comments.

In 1994, the City of Stirling referred District Planning Scheme No. 2 Amendment 209 – rezoning, Outline Development Plan (ODP) and Careniup Swamp rehabilitation plan to the then Department of Environmental Protection (DEP). The amendment identified a proposed core area – Careniup Swamp (Attachment 1). The DEP concluded that the overall environmental impact of the proposal was not so severe as to warrant formal assessment by the EPA.

The City of Stirling adopted this core area in its Local Planning Scheme No. 3 and surrounding development has remained consistent with this previously identified 'core area' (Attachment 2).

The Office of the EPA (OEPA) recognises that a portion of the site proposed to be developed falls within the boundaries of the EPA's *Environmental Protection Policy Swan Coastal Plain Lakes 1992* (EPP) and would result in the loss of a portion Careniup Swamp. However, given that the proposed structure plan remains consistent with the Careniup Swamp ODP, which was approved in 1994, the OEPA does not consider that referral of the structure plan or subdivision to the EPA is warranted.

The OEPA recommends that ongoing liaison with the Department of Environment and Conservation and Department of Water is undertaken

during the preparation of the subdivision guide plan. The OEPA would expect the Responsible Authority to refer the subdivision if any new issues are identified that were not addressed in the Careniup Swamp ODP.

Should you require any further information please contact the officer for this project, Amy Sgherza, whose details are cited above.

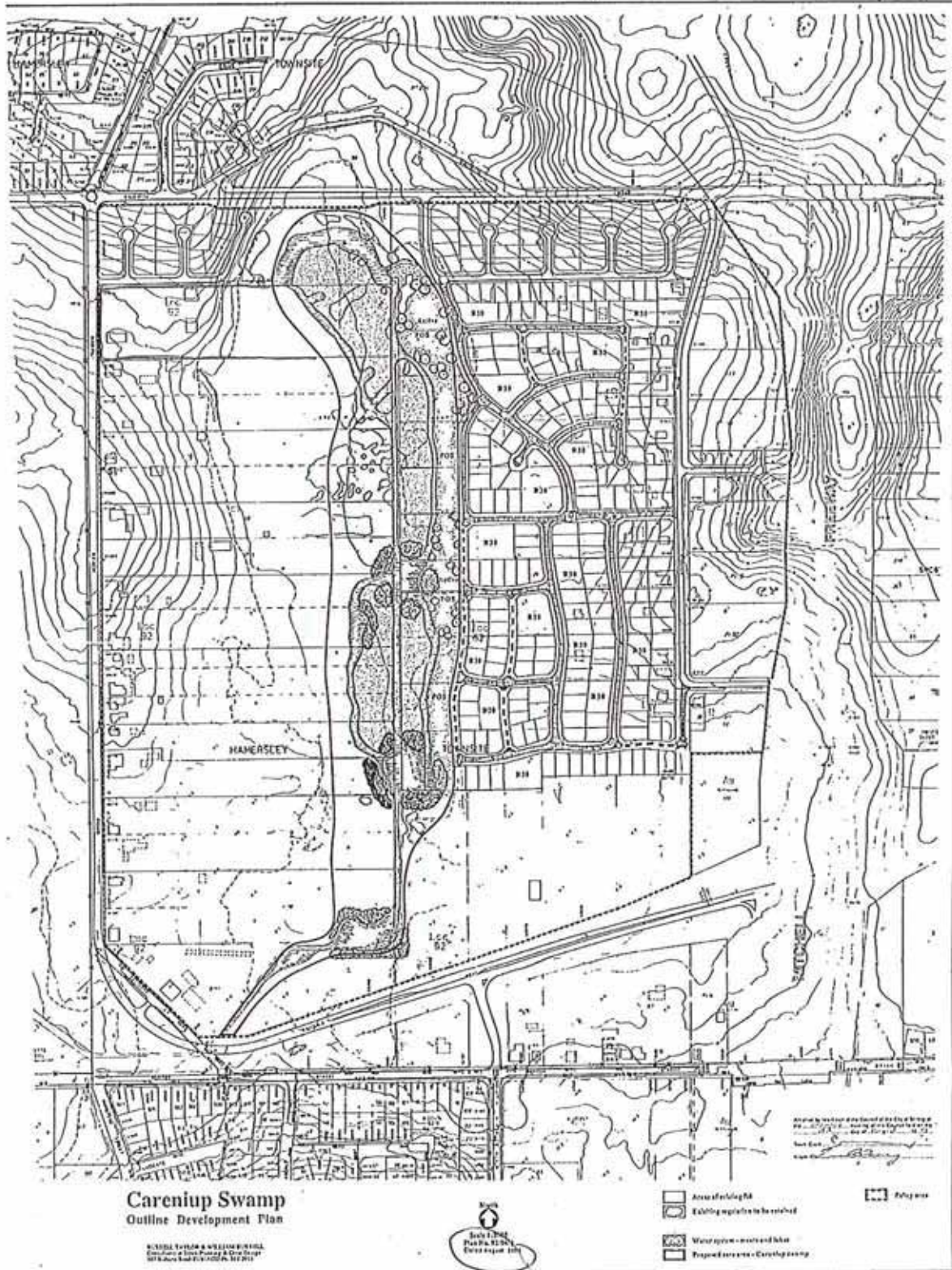
Yours sincerely

A handwritten signature in blue ink, appearing to read "A. Sutton".

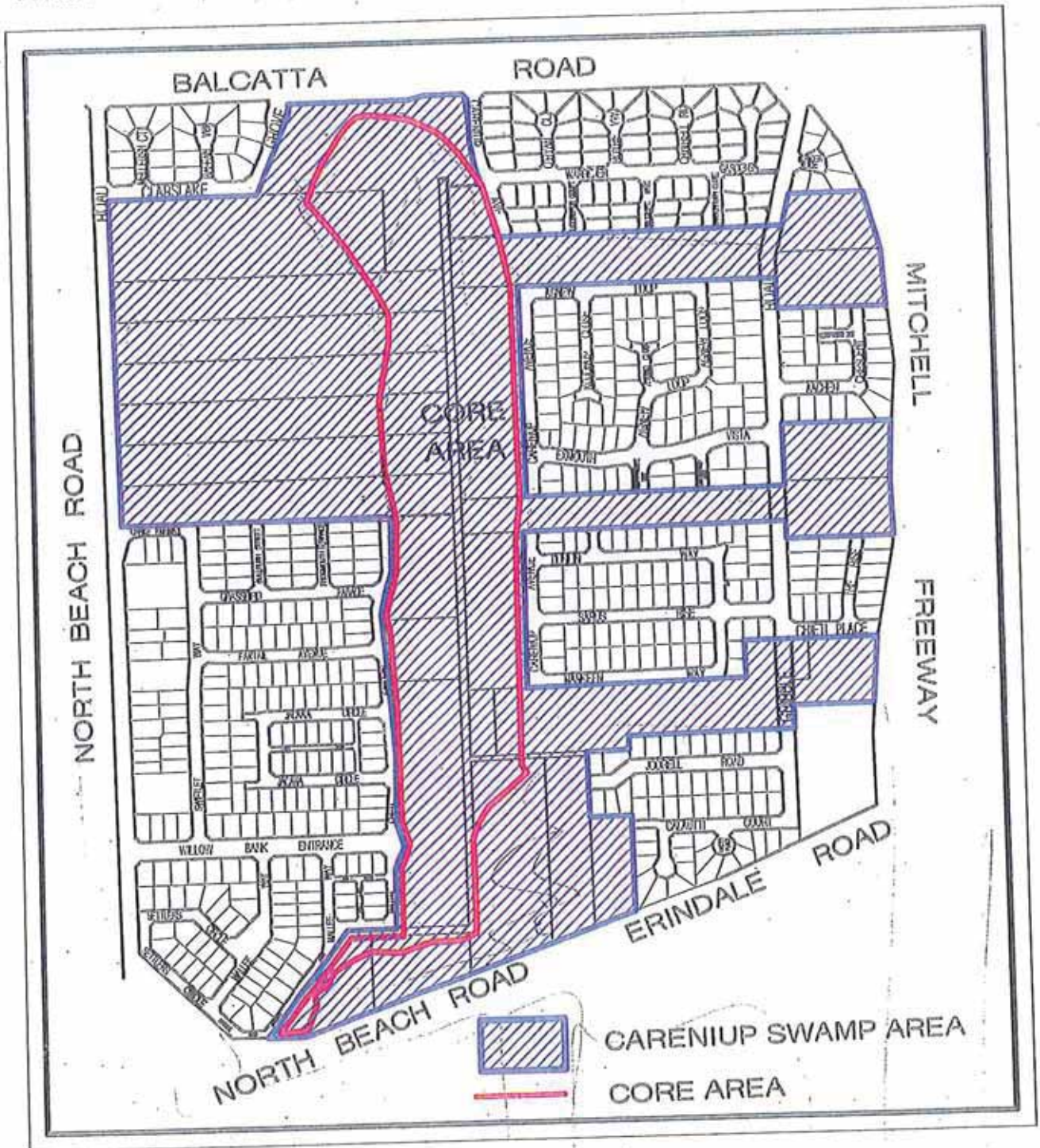
Anthony Sutton
Director
Assessment and Compliance Division

27 December 2012

Encl. Attachment 1 – Careniup Swamp ODP
Attachment 2 – City of Stirling LPS3 Careniup Swamp Area



PLAN 1 - Careniup Swamp Rehabilitation Plan





APPENDIX 3

LOCAL WATER MANAGEMENT STRATEGY



ROWEGROUP



Lot 2 North Beach Road Gwelup
Local Water Management Strategy

March 2017



Client: Darron Baynham

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Disclaimer

This document is published in accordance with and subject to an agreement between Hyd2o and the Client for whom it has been prepared, and is restricted to those issues that have been raised by the Client in its engagement of Hyd2o. It has been prepared using the skill and care ordinarily exercised by hydrologists in the preparation of such documents. Hyd2o recognises site conditions change and contain varying degrees of non-uniformity that cannot be fully defined by field investigation. Measurements and values obtained from sampling and testing in this document are indicative within a limited timeframe, and unless otherwise specified, should not be accepted as conditions on site beyond that timeframe.

Any person or organisation that relies on or uses the document for purposes or reasons other than those agreed by Hyd2o and the Client does so entirely at their own risk. Hyd2o denies all liability in tort, contract or otherwise for any loss, damage or injury of any kind whatsoever (whether in negligence or otherwise) that may be suffered as a consequence of relying on this document for any purpose other than that agreed with the Client.

Executive Summary

Hyd2o was commissioned by Darron Baynham to prepare this Local Water Management Strategy (LWMS) to support the proposed subdivision development of Lot 2 North Beach Road within the suburb of Gwelup.

The site is located approximately 12 km north west of Perth City Centre within the City of Stirling. The site has an approximate area of 3.3 ha and is bound by existing residential development to the north, Lots 500 and 501 to the south, Karrinyup Golf Course to the west and Careniup Swamp to the east.

The proposed development consists of 63 residential lots <500m² each, one larger lot for the existing veterinary practice, and one POS reserve located adjacent to Careniup Swamp. The development area represents approximately 2.7 ha of the site and has been developed in accordance with the City of Stirling Local Planning Scheme (LPS) No. 3 and associated Careniup Swamp Rehabilitation Plan.

The site is largely cleared and contains one existing residential dwelling and a veterinary practice. Careniup Swamp located to the east, is mapped as a resource enhancement wetland, with a smaller portion mapped as an EPP lake. The swamp forms part of the Water Corporations Main Drainage system, which services the adjacent residential area.

Topography of the site slopes from approximately 11 m AHD at the northern boundary to 10 m AHD at the western boundary and 6 m AHD at the eastern boundary. Elevated areas in the western portion of the site are located well above the groundwater table, with the water table expressing itself at natural surface in the east.

The proposed stormwater management system will retain and infiltrate the 1 in 1 year average recurrence interval (ARI) event on site, with events greater than 1 year ARI overflowing to Careniup Swamp in accordance with Water Corporation overarching drainage planning for the area.

This LWMS has been prepared in accordance with the principles, objectives, and key criteria of Better Urban Water Management (Western Australian Planning Commission, 2008). In excess of 40 years of groundwater and wetland water quality and level data from nearby Department of Water (DoW) bores, and 11 months of onsite measurements by Hyd2o, have been use to inform the development of this LWMS.

Implementation of the strategy will be undertaken in accordance with Better Urban Water Management through the development and implementation of Urban Water Management Plans for individual stages of development within the site.

Local Water Management Strategy Summary

Strategy Elements	LWMS Method & Approach
Water Use Sustainability	
Water Efficiency	<ul style="list-style-type: none"> • 5 Star Building Standards (water efficient fixtures and fittings). • Use of native plantings in POS / wetland area. • Maximise infiltration of stormwater at source.
Water Supply	<ul style="list-style-type: none"> • Water Corporation IWSS for lots with rainwater tanks optional. • Long term irrigation of Public Open Space / wetland area via groundwater bore.
Wastewater	<ul style="list-style-type: none"> • Water Corporation reticulated sewerage.
Stormwater	
Flood Protection	<ul style="list-style-type: none"> • No development within wetland core area. • 100 year overflow to Careniup Swamp. • Establish minimum habitable floor levels at 0.5m above the 100 year ARI flood level. • Provide flood paths for overland flows which exceed the capacity of piped drainage.
Serviceability	<ul style="list-style-type: none"> ▪ Road drainage system designed so roads will be passable in the 1 in 5 year event. ▪ 5 year overflow to Careniup Swamp.
Ecological Protection	<ul style="list-style-type: none"> ▪ 1 year 1 hour storm event to be retained on site. ▪ Use of soakwells at lots scale. ▪ Total storage volume of 85 m³ and area of 348 m² required to manage flood events up to 1 year ARI, representing approximately 1% of total site area. ▪ Design accommodates future potential drainage contribution from area to north of the site. ▪ Bioretention area established at 2% of connected impervious area within 1 year storage area. ▪ Wetland boundary established in accordance with the Careniup Swamp Rehabilitation Plan contained in City of Stirling (2013). ▪ Implement non-structural controls.
Groundwater	
Fill & Subsoil Drainage	<ul style="list-style-type: none"> • A combination of fill and subsoil drainage will be utilised to achieve clearance to groundwater. • Subsoil will be free draining and receive appropriate treatment prior to discharge.
ASS & Contamination	<ul style="list-style-type: none"> • ASS to be investigated as a separate process and reported in UWMP.

1. Introduction

Hyd2o was commissioned by Darron Baynham to prepare this Local Water Management Strategy (LWMS) to support the proposed subdivision development of Lot 2 North Beach Road within the suburb of Gwelup (herein referred to as the site).

The site is located approximately 12 km north west of Perth City Centre within the City of Stirling. The site has an approximate area of 3.3 ha and is bound by existing residential development to the north, Lots 500 and 501 to the south, Karrinyup Golf Course to the west and Careniup Swamp to the east.

This LWMS provides a total water cycle management approach to development and has been prepared consistent with the overarching City of Stirling Local Planning Scheme No. 3 and Better Urban Water Management (Western Australian Planning Commission (WAPC, 2008). This document provides the outcomes of site specific analysis relating to groundwater and surface water and provides a clear vision in terms of adopting best management practices to achieve water sensitive design.

LWMS Checklists are contained as Appendix A.

1.1 Planning Background

The site is located within the City of Stirling Local Planning Scheme (LPS) No. 3 area and is identified as a development zone (City of Stirling, 2013). The proposed residential development complies with the LPS.

The site is located within the zone identified as the Careniup Swamp Special Control Area, and the LPS scheme text provides special provisions for this area (City of Stirling, 2013).

The LPS scheme text details a Careniup Swamp Rehabilitation Plan, which defines the core area of the wetland for retention with development. The boundary of the wetland core area identified in the LPS has been used as the basis of structure planning for areas adjacent to the swamp.

Table 1: Integrated Planning and Urban Water Management Process

Planning Phase	Planning Document	Urban Water Management Document and Status
Local	Local Structure Plan Lot 2 North Beach Rd Gwelup	Lot 2 North Beach Rd Gwelup Local Water Management Strategy THIS DOCUMENT
Subdivision	Subdivision Application	Urban Water Management Plan (for individual subdivision applications) FUTURE PREPARATION

1.2 Key Documents and Previous Studies

This LWMS uses the following key documents to define its principles, criteria, and objectives:

- Better Urban Water Management (WAPC, 2008).
- Stormwater Management Manual for WA (Department of Water, 2007).
- Decision Process for Stormwater Management in WA (Department of Water, 2009a).
- City of Stirling Local Planning Scheme No. 3 (City of Stirling, 2013).
- Karrinyup Gwelup Local Area Plan (City of Stirling 2010).
- Proposed Residential Subdivision Lot 2, 455 North Beach Rd, Gwelup, WA, Geotechnical Investigation Report (CMW Geosciences, 2015).

2 Proposed Development

The structure plan for the site is shown in Figure 2.

Consideration of the predevelopment environment of the site and existing constraints have guided the development of this plan. The proposed development consists of 63 residential lots <500m² each and one POS reserve located adjacent to the Careniup Swamp. The existing veterinary practice is to be retained post-development.

The development area represents approximately 2.7 ha of the site.

The extent of the development area has been established in accordance with the City of Stirling Local Planning Scheme (LPS) No. 3 and associated Careniup Swamp Rehabilitation Plan.

3 Pre-Development Environment

3.1 Site Conditions

The site is largely cleared and contains several existing residential dwellings and a veterinary practice (Figure 3). Existing residential development and proposed residential development is located to the north and south respectively, and the Careniup Swamp to the east.

Topography of the site slopes from approximately 11 mAHD at the northern boundary of the site to 6 mAHD at the eastern boundary (Figure 3).

Historical aerial imagery shows that the project area and adjacent lots to the north and south were previously used for market gardening for an extended length of time.

The project area is located within the Perth Coastal and Gwelup Underground Water Pollution Control Area (UWPCA), which is a Priority 3 source protection area. Land uses such as residential, commercial and light industrial developments are permissible in P3 areas and coexist with public water supply sources in these areas.

3.2 Geotechnical

Environmental geology mapping on the Perth Metropolitan Regional Sheet 2034 II and part 2034 III and 2134 III (Gozzard, 1986) is shown in Figure 4, indicating the site is characterised by areas of:

- Cps – PEATY CLAY – dark grey to black at surface with variable sand content of lacustrine origin. This is located in the eastern portion of the site in vicinity of the Careniup Swamp.
- S7 – SAND – Pale grey to white medium grained well sorted sub angular quartz. This is located in the western portion of the site covering the majority of the development area.

Pre-development monitoring involved the installation of two groundwater bores within the site (Section 3.5) (Figure 4) by Hyd2o on 9 March 2015 to maximum depths of 8.25 m below natural surface.

The lithological logs indicate that the subsurface profile is generally sandy, with the potential for areas of limestone at the western boundary of the site. Lithological logs taken by Hyd2o at the time of bore installation are attached as Appendix B. The findings from lithological logs are consistent with surface geology characteristics identified by Gozard (1986), with the exception of site GWMB1 which encountered limestone.

A geotechnical investigation of the site was undertaken by CMW Geosciences in March 2015 (CMW Geosciences, 2015). The investigation spanned the eastern portion of the site and was focused on identifying areas of swamp deposits. The investigation identified swamp deposits at all borehole locations (Figure 4), consistent with extents identified in regional mapping.

The geotechnical report is included as Appendix C.

3.2.1 Acid Sulphate Soils

According to Western Australian Planning Commission (2003), the eastern portion of the site has a moderate to high level risk of acid sulphate spoil disturbance occurring within 3m of natural soil surface (Figure 4).

3.2.2 Contaminated Sites

A search of the Department of Environment and Conservation's Contaminated Sites Database determined that there are no known contaminated areas within the site.

3.3 Wetlands

According to the DEC's Geomorphic Wetlands of the Swan Coastal Plain dataset, Careniup Swamp is classified as a sumpland, resource enhancement wetland (Figure 5). EPA's Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 also identifies part of the wetland as an EPP Lake (Government of Western Australia, 1992) (Figure 5).

As previously discussed in Section 1.1, Careniup Swamp is zoned as a Special Control Area allowing for development to occur consistent with the detailed Careniup Swamp Rehabilitation Plan contained in City of Stirling (2013), which defines the core area of the wetland for retention following development.

The boundary of the wetland core area is shown in Figure 5 and an extract from the City of Stirling Local Planning Scheme No. 3 regarding the provisions in place for the Careniup Swamp Special Control Area included as Appendix D.

The boundary of the wetland core area in the LPS is used to define development boundaries adjacent to the wetland (Bruce Gardner, Senior Strategic Planning Officer City of Stirling, pers comm).

Many existing and recent residential developments adjacent to Careniup Swamp intersect the mapped wetland boundaries.

3.4 Surface Water Hydrology

The site drains from west to east toward Careniup Swamp, via overland flow. There are currently no defined drainage flow paths within the site and it has no external catchments contributing flow into the site.

Careniup Swamp is part of the Water Corporation Main Drainage system, and is a compensating basin receiving stormwater runoff from adjacent residential development areas. City of Stirling (2013) outlined the need to maintain 26,000m³ of capacity within the wetland core area for drainage purposes following development of the adjacent areas.

Development was also required consider a maximum water level of 7 mAHD and minimum operating water levels of 6.3 mAHD for the wetland (City of Stirling 2013). Recent discussions with the Water Corporation (James Wegener pers comm) however have indicated a maximum top water level for Careniup Swam of 6.6 mAHD (100 year ARI) to be used for design purposes. Hyd2o understand this advice is based on the Water

Corporation's latest modelling of the drainage system in the area and this advice supersedes the previous 7 mAHD level contained in City of Stirling (2013).

Further details regarding provisions for the Careniup Swamp Special Control Area are included in Appendix D.

3.5 Groundwater Hydrology

3.5.1 Groundwater Levels

Local groundwater characteristics have been established using data obtained from local and site specific groundwater bores. All monitoring bores associated with these investigations (Hyd2o and Department of Water (DoW) bores) are shown in Figure 6.

Groundwater level monitoring was undertaken by Hyd2o at four bores, GW1, GW2, GW3 and GW4, located on adjoining Lots 500 and 501, four DoW bores, and one DoW staff gauge, between March 2014 and December 2014.

Two additional monitoring bores, GWMB1 and GWMB2, were installed at the site and monitored by Hyd2o for quality and levels on 19 March 2015 along with bores GW1, GW2 and GW4, DoW monitoring bores and the DoW staff gauge.

Hyd2o groundwater monitoring data covering both these period is included in Appendix F.

Long-term groundwater monitoring data, measured between July 1974 and January 2015, was obtained from the DoW for four bores, GM4, GM8, GM9 and GM33, located between approximately 500 m and 1 km from the site, as well as for one DoW staff gauge located in the Careniup Swamp. Hydrographs for all four DoW bores are included in Appendix E.

Groundwater has a low gradient, flowing in an east-west direction. Groundwater levels ranged from 3.46 m AHD at bore GWMB1 and 5.65 m AHD at bore GW4 (Table 2).

Tables 3 and 4 outline the details of the calculated average annual maximum groundwater level (AAMGL) and maximum groundwater levels (MGL) for the site. The AAMGL for bores GW1-GW4 were calculated by Hyd2o for adjacent Lots 500 and 501 based on peak groundwater levels recorded on 29 August 2014 and long term DoW level records.

The AAMGL and MGL of bore GW1 and GW3, located immediately adjacent to Careniup Swamp, were referenced to long term levels recorded at the nearby DoW staff gauge to take into account the influence of Water Corporation infrastructure on surface water level at Careniup Swamp. Bores GW2 and GW4 were referenced to four surrounding DoW long term monitoring bores.

The AAMGL for additional bores GWMB1 and GWMB2 were calculated using a correction factor derived from the difference between levels recorded on the 19 March 2015 and previously calculated AAMGLs of bores GW2 and GW4. This ensures that design groundwater levels for Lot 2 are consistent with those used for design at adjacent Lots 500 and 501.

The AAMGL is estimated to range from 4.44 m AHD (at GWMB1) to 6.27 m AHD (at GW3). AAMGL varied from approximately 6.44 m to 0.55 m below existing natural surface at bore

locations (Figure 7). The MGL is estimated to range from 5.19 m AHD (at GWMB1) to 6.96 m AHD (at GW3).

The estimated MGL level for the site in the area adjacent to Careniup Swamp is generally consistent with the maximum recorded groundwater level contours detailed in DoW's online Perth Groundwater Atlas (2014b). Hyd2o maximum groundwater levels adjacent to North Beach Rd are lower than DoW (2014b) estimates, possibly due to irrigation impacts of the Lake Karrinyup Country Club golf course.

Table 2: Pre Development Groundwater Levels

	Hyd2o Monitoring Bores						DoW Monitoring Bores					DoW Staff Gauge
	GW1	GW2	GW3	GW4	GWMB1	GWMB2	GM4	GM8	GM9	GM33	-	
Groundwater Level (m AHD)												
20/02/2014	5.53	4.81	5.55	3.67	-	-	-	-	-	-	-	5.60
24/03/2014	5.37	4.58	5.46	3.44	-	-	4.47	3.67	4.56	6.19	-	5.50
29/04/2014	5.40	4.53	5.46	3.30	-	-	4.40	3.49	DRY 4.62	-	-	5.60
27/05/2014	5.82	4.79	5.80	6.53	-	-	4.59	3.75	4.37	6.13	-	6.05
23/06/2014	6.04	5.04	6.03	3.68	-	-	4.80	3.96	4.26	5.94	-	6.10
23/07/2014	6.18	5.38	6.20	3.95	-	-	4.98	4.14	4.19	5.84	-	6.10
29/08/2014	5.99	5.38	6.05	4.21	-	-	5.13	4.44	DRY 4.62	-	-	6.05
24/09/2014	6.07	5.54	6.13	4.41	-	-	5.31	4.62	4.05	5.60	-	6.15
31/10/2014	5.95	5.45	5.92	4.49	-	-	5.34	4.73	4.12	5.60	-	5.95
01/12/2014	5.91	5.31	5.88	4.35	-	-	5.23	4.59	4.21	5.64	-	6.10
19/03/2015	5.65	4.80	-	3.63	3.46	4.24	4.74	3.76	7.91	9.08	-	5.80

Table 3: Lot 500 and 501 Bore AAMGLs and MGLs

Bore	Natural Surface (m AHD)	19/03/2015 Level (m AHD)	AAMGL (m AHD)	Depth to AAMGL (m)	AAMGL Correction Factor (m)	MGL (m AHD)	Depth to MGL (m)	MGL Correction Factor (m)
GW1	6.76	5.65	6.21	0.55	-	6.76*	0.00*	-
GW2	7.97	4.80	5.76	2.21	+0.96	6.53	1.44	+1.73
GW3	7.12	-	6.27	0.85	-	6.96	0.16	-
GW4	11.07	3.63	4.63	6.44	+1.00	5.36	5.71	+1.73
Average correction factor applied to bores GWMB1 and GWMB2					+0.98	-	-	+1.73

* Corrected to natural surface

Table 4: Lot 2 Bore AAMGLs and MGLs

Bore	Natural Surface (m AHD)	19/03/2015 Level (m AHD)	AAMGL (m AHD)	Depth to AAMGL (m)	MGL (m AHD)	Depth to MGL (m)
GWMB1	10.66	3.46	4.44	6.22	5.19	5.47
GWMB2	11.02	4.24	5.22	5.80	5.97	5.05

3.5.2 Groundwater Quality

Groundwater quality monitoring was undertaken by Hyd2o at four bores, GW1, GW2, GW3 and GW4, located on adjoining Lots 500 and 501, between March 2014 and December 2014, using low-flow pumping groundwater sampling techniques. In addition, five groundwater bores (GW1, GW2, GW4, GWMB1, and GWMB2) were sampled for groundwater quality on 19 March 2015. All monitoring data collected over both period is included in Appendix F.

Physical parameters (temperature, electrical conductivity, pH) were measured in situ. Samples were sent to a NATA approved laboratory for analysis of total suspended solids, total nitrogen, total Kjeldahl nitrogen, ammonia, nitrate, nitrite, total phosphorus, filterable reactive phosphorus, and heavy metals (arsenic, cadmium, chromium, copper, nickel, lead, mercury, and zinc).

Groundwater quality sampling results, for all bores sampled, are outlined in Table 5, with full results contained in Appendix F and lab reports in Appendix G. Results are summarised below:

- pH in groundwater across all readings ranged from 6.53 to 7.02. The average across all bores was 6.80 suggesting the groundwater fits within the ANZECC (2000) guideline range of 6.5-8 pH.
- EC ranged from 512 µs/cm to 12575 µs/cm across all groundwater samples, with an average of 7487 µs/cm.
- Across all sampling locations, values for total nitrogen (TN) ranged from 1.6 mg/L to 26 mg/L. The average value across all bores was 8.3 mg/L, which is above the ANZECC (2000) guideline value of 1.2 mg/L. The highest nutrient values were recorded at the eastern site adjacent to Careniup Swamp.
- Total phosphorous ranged from <0.05 to 6.5 mg/L across all bores, with an average of 0.48 mg/L, which exceeds the ANZECC (2000) value of 0.065 mg/L.
- With respect to metals, Mercury was below detectable limits for all samples, Cadmium below detectable limits for all sites except GW2 which was within a 95% level of protection, Lead below detectable limits for all sites except GW2 which was within a 90% level of protection, and Chromium detectable only at GW1-GW2 and GWMB2 and within a 95% level of protection. On average across all sites, Arsenic was within a 99% level of protection, Zinc within a 95% level of protection, and Copper within <80% level of protection. Nickel was within a 99% level of protection across all sites except GWMB1 where it was undetectable.

The high nutrient levels are consistent with the site historical land use as a market garden.

Table 5: Groundwater Quality

Parameter	Mean Parameter Values						Carenilup Swamp (CoS '12/'13 averages)	ANZECC
	GW1	GW2	GW3	GW4	GWMB1	GWMB1		
Ec (µS/cm)	8440	914	2036	729	1030	1321	770	120-300
pH	6.73	6.67	7.40	6.80	7.02	6.87	7.6	6.5-8.0
TSS (mg/L)	1102	186	903	214	520	730	6	-
TN (mg/L)	18.2	6.2	14.8	11.5	1.6	4.0	1.22	1.2
TKN (mg/L)	18.2	3.5	14.8	2.3	1.6	4.0	1.18	n/a
Ammonia (mg/L)	5.66	0.90	7.85	0.09	0.16	1.70	0.37	0.08
Phosphate (mg/L)	0.07	0.06	0.008	0.01	<0.005	<0.005	-	-
Nitrite as N (mg/L)	<0.005	0.016	<0.005	1.450	<0.005	<0.005	-	n/a
Nitrate as N (mg/L)	0.01	3.25	0.04	8.40	0.01	0.01	-	n/a
TP (mg/L)	1.97	0.23	0.40	<0.05	0.11	0.13	0.079	0.065

4 Design Criteria

Key design criteria for the site are shown in Table 6 and have been established consistent with criteria specified in the key reference documents previously detailed in Section 1.3

These design criteria are used in Sections 5, 6 and 7 together with the identified constraints and opportunities of the predevelopment environment (Section 3) to establish the water management strategy for the site.

Table 6: Design Criteria

Strategy Elements	Criteria
Water Use Sustainability	
Water Efficiency	<ul style="list-style-type: none"> Reduce consumptive use through adoption of waterwise practices.
Water Supply	<ul style="list-style-type: none"> Develop “fit for purpose” water supply strategy, and minimise potable water use where drinking quality water is not essential.
Wastewater	<ul style="list-style-type: none"> Provide a wastewater system which meets agency requirements.
Stormwater	
Flood Protection	<ul style="list-style-type: none"> 100 year overflow to Careniup Swamp Establish minimum habitable floor levels at 0.5m above the 100 year ARI flood levels. Provide flood paths for overland flows which exceed the capacity of piped drainage.
Serviceability	<ul style="list-style-type: none"> Road drainage system to be designed so that roads will be passable in the 1 in 5 year event. 5 year overflow to Careniup Swamp
Ecological Protection	<ul style="list-style-type: none"> 1 year 1 hour storm event (15mm) to be retained on site. Bioretention areas established at 2% of connected impervious areas. Wetland boundary established in accordance with the Careniup Swamp Rehabilitation Plan contained in City of Stirling (2013). Implement non-structural controls.
Groundwater	
Fill Requirement & Subsoil Drainage	<ul style="list-style-type: none"> Establish development levels with acceptable clearance above post development groundwater levels. Provide subsoil drainage to control any post development groundwater rise.
Acid Sulphate Soils & Contamination	<ul style="list-style-type: none"> Management of Acid Sulphate Soils to be handled as a separate process to LWMS consistent with DoE (2004b) requirements.

5 Water Use Sustainability Initiatives

5.1 Water Efficiency Measures

Development of the site will lead to an increased demand of potable water for residential use and irrigation of gardens and POS areas. Water conservation measures will be implemented to reduce scheme water consumption within the development will be consistent with Water Corporation’s “Waterwise” land development criteria including:

- Promotion of use of waterwise practices including water efficient fixtures and fittings (taps, showerheads, toilets, rainwater tanks, waterwise landscaping).
- All houses to be built to 5 star building standards.
- Use of native plants in POS and wetland area.
- Maximising on site retention of stormwater (where practicable).

5.2 Water Supply

Potable water supply to future homes in the site will be via the Water Corporation Integrated Water Supply System (IWSS).

The site is located within the Gwelup groundwater management area (GMA) and Gwelup groundwater subarea. Table 7 summarises the current quotas and allocation according to the Department of Water’s online Water Register (2014b), indicating both the Superficial and Mirrabooka aquifers as being fully allocated.

A groundwater licence, with an available allocation of 26,425 kL/annum from the superficial aquifer, is currently registered to the site. It is intended to be used for irrigation of the Public Open Space/wetland area.

Rainwater tanks have been identified as a non-potable source to be integrated as part of the domestic water supply scheme to assist in reducing stormwater generation and minimise scheme water importation. Further details of rainwater tank implementation will be provided at UWMP stage.

Table 7: Groundwater Resource and Licenced Allocation

Groundwater Area	Subarea	Aquifer	Allocation Limit	Water Availability
Gwelup	Gwelup	Superficial	7.95 GL	Fully allocated
Gwelup	Gwelup	Mirrabooka	3.60 GL	Fully allocated

5.3 Wastewater Management

Wastewater will be deep sewerage (reticulated) with management by the Water Corporation.

6 Stormwater Management Strategy

Stormwater management is proposed to be undertaken consistent with DoW water sensitive design practices. The system will consist of a series of lot soakwells, road drainage system comprising pipes, and a bioretention/infiltration area to provide water quantity and quality treatment for stormwater generated from the proposed development.

6.1 Stormwater Modelling

Stormwater modelling for the site was performed using XP-Storm to determine flood storage requirements and provide an assessment of local structure plan areas required for drainage purposes.

The post development catchment area for the flood storage is shown in Figure 8.

The storage is designed to detain and infiltrate the 1 in 1 year ARI event, with larger events permitted to overflow to Careniup Swamp, via an overflow spillway which will be established as an overland flow path.

The proposed runoff rate for the 1 in 1 year ARI event has assumed the use of soakwells within lots, with only road reserve runoff contributing to storage requirements. For events greater than 1 in 1 year ARI, a runoff coefficient of 20% has been adopted from lots.

The design storms modelled by XP-Storm were calculated internally by the model with reference to the methodology in Australian Rainfall & Runoff (AR&R) (Institution of Engineers, Australia, 2000) and the Bureau of Meteorology Computerised Design IFD Rainfall System. The rainfall temporal pattern was assumed to be spatially uniform across the catchment. Storm durations modelled ranged from 60 minutes to 72 hours.

Modelling results are shown in Table 8 and Figure 8. The storage shape shown in Figure 8 is indicative only for determination of area requirements. Note the location of the 1 year storage area has been established outside the development area and within the area required to be graded to Careniup Swamp.

Figure 9 shows a concept cross section of the proposed 1 year ARI stormwater storage area.

The final storage area configuration (side slopes etc), location, and elevation will be documented in the UWMP and will be dependent on final earthworks, drainage, and road design levels for the development.

Minor refinements to catchment areas shown in this report may occur as detailed design proceeds, and stormwater modelling will be updated accordingly if required during the UWMP process.

All building floor levels will comply with Water Corporation requirements for a 0.5 m clearance above the Careniup Swamp 100 year ARI flood level of 6.6 mAHD (James Wegener, Water Corporation, pers comm).

Table 8: Stormwater Storage Sizing

Catchment Details	
Contributing Lot Area (Ultimate) (ha)	2.09
Contributing Road Reserve Area (ha)	0.63
Roads (% runoff)	90%
Lots (for events >1 year ARI) (% runoff)	20%
1 in 1 Year ARI EIA (Roads) (ha)	0.57
>1 Year ARI EIA (Roads and Lots) (ha)	0.99
Storage Parameters	
Base Area (m ²)	220
Side Slopes	1:6
Approximate Base Invert (m AHD)	6.60
Bioretention Area	
Required Area (m ²) (2% of EIA)	114
1 Year 1 Hour ARI Event (15mm)	
Flood Rise (m)	0.30
Volume (m ³)	85
TWL Surface Area (m ²)	348
TWL (m AHD)	6.90
5 Year ARI Event	
Peak Overflow (m ³ /s) to wetland via spillway	0.10
100 Year ARI Event	
Peak Overflow(m ³ /s) to wetland via spillway	0.21

6.2 BMP Water Quality Performance

Bioretention areas are calculated as 2% of the effective impervious area (EIA) (Table 8), and provide a guide for storage requirements and areas for water quality treatment consistent with DoW requirements (DoW, 2009a).

The area required for bioretention will be less than required for 1 year ARI event storage.

Table 9 details a summary from DoW's Stormwater Management Manual for Western Australia (2007) of expected pollutant removal efficiencies for various WSUD measures in relation to water quality design criteria. While DoW (2007) does not provide expected pollutant removal efficiencies for all BMP's, application of a treatment train approach using a combination of the non-structural and structural measures will achieve the design objectives for water quality as detailed in Better Urban Water Management (WAPC, 2008).

Table 9: BMP Water Quality Performance

Parameter	Design Criteria via BUWM (WAPC,2008) (required removal as compared to a development with no WSUD)	Structural Controls Nutrient Output Reduction ¹	
		Vegetated Swales/ Bioretention Systems	Detention/ Retention Storages
Total Suspended Solids	80%	60-80%	65-99%
Total Phosphorus	60%	30-50%	40-80%
Total Nitrogen	45%	25-40%	50-70%
Gross Pollutants	70%	-	>90%

1. Typical Performance Efficiencies via DoW (2007)

6.3 Non-Structural Controls

This LWMS proposes a treatment train approach to water quality management which will include non- structural as well as structural controls:

- **Non-Structural Controls**
 - Planning: POS and storage location/configuration
 - Landscape: Native plantings, WSUD integration
 - Maintenance: wetland and storage areas, street sweeping, manhole education
 - Monitoring: Pre and post development program and review
- **Structural Controls**
 - Soakwells at lot scale to minimise runoff
 - Bioretention storage and 1 year treatment area
 - Overland flow path to wetland for major events

Measures adopted represent known best management practice as detailed in the DoW’s Stormwater Management Manual for Western Australia (2007).

7 Groundwater Management Strategy

7.1 Fill and Subsoil Drainage

Development levels in the site will be largely dominated by fill requirements to achieve adequate separation to groundwater, rather than clearance above the Careniup Swamp 100 year flood level.

Minimum separation between building floor levels for development and groundwater will be achieved by a combination of fill and subsoil drainage to provide protection against any post development groundwater rise.

Subsoil drainage is likely to be confined to the eastern portion of the development area. All subsoil drainage is proposed to be located at the AAMGL as a control groundwater level, with lots provided with a minimum 1.5 m clearance above the invert of the subsoil drains.

The extent of the subsoil area will be identified at UWMP stage. All subsoil drainage will be free draining in accordance with DoW requirements and treated for water quality prior to discharge.

Finished lot levels and fill requirements are a detailed design issue to be addressed during the preparation of detailed engineering design drawings and preparation of the UWMP, and will be ultimately submitted for council approval at that stage. A preliminary bulk earthwork drawing is included as Appendix H.

7.2 Acid Sulphate Soils

Management of Acid Sulphate Soils (ASS) will be addressed as a separate study to this LWMS. Details regarding the outcomes of this study will be included as part of the Urban Water Management Plan (UWMP).

All assessment and management of ASS will be conducted in accordance with the Acid Sulphate Soil Guideline Series Identification and Investigation of Acid Sulphate Soils (DoE, 2004b).

8 Urban Water Management Plans

Consistent with processes defined in WAPC (2008), an Urban Water Management Plan (UWMP) will be developed and submitted to support a subdivision application for the site.

The UWMP will address:

- Demonstrated compliance with LWMS criteria and objectives to the satisfaction of the City of Stirling and DoW.
- Agreed/approved measures to achieve water conservation and efficiencies of water use.
- Detailed stormwater management design including the size, location and design of public open space areas, integrating major and minor flood management capability.
- Management of groundwater levels including proposed cut/fill level, and any subsoil drainage inverts (if/where required).
- Specific structural and non-structural BMPs and treatment trains to be implemented including their function, location, maintenance requirements, expected performance and agreed ongoing management arrangements.
- Management of subdivisional works
- Implementation plan including roles, responsibilities, funding and maintenance arrangements.
- Specific monitoring and reporting to be undertaken consistent with the monitoring program defined in the LWMS.
- Contingency plans (where necessary).

More detail on stormwater storage integration will be provided during the development of the UWMP, including refinement of stormwater modelling, preparation of landscape plans (species selection and treatments), and detailed engineering design drawings.

Preparation of the UWMP will be the responsibility of the developer.

9 Monitoring

9.1 Predevelopment

An extensive amount of groundwater monitoring data is available in close proximity to the site, which includes nine months of monitoring at adjoining lots 500 and 501 in 2014, a one off measurement of existing onsite bores as well as two additional bores installed onsite in March 2015, and an extensive monitoring record of nearby DoW bores. This data is considered sufficient information for informing design.

Results collected to date have been reported in Section 3.5 and Appendix E-F and have been used to inform this LWMS.

9.2 Post Development

A post-development groundwater monitoring program is proposed to be undertaken in combination with adjoining development at Lots 500 and 501 at one of the pre-development groundwater monitoring bores located near the eastern development area boundary adjacent to the wetland. The following frequency of monitoring is proposed:

- Monthly groundwater level measurements.
- Quarterly groundwater quality measurements.

Groundwater quality will be monitoring quarterly (typically January, April, July, October) for physical parameters (pH, electrical conductivity), nutrients (total nitrogen, total Kjeldahl nitrogen, ammonia, nitrate, nitrite, total phosphorus, and filterable reactive phosphorus) and heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, aluminium, manganese, arsenic and lead).

All samples will be analysed at a NATA approved laboratory.

The groundwater monitoring schedule will be undertaken for a two year period. An annual report will be prepared summarising the results of the program. Commencement of monitoring will be negotiated in due course and will follow the completion of development works at both Lot 2 and Lots 500 and 501.

Table 10: Post Development Monitoring Program

Monitoring	Parameter	Location	Method	Frequency and Timing
Groundwater	Water Level (m AHD)	1 bore within development area and 2 DoW bores	Electrical depth probe or similar	Quarterly
	pH, EC, nutrients, metals	1 bore within development area adjacent to wetland	Pumped bore sample	Quarterly (Jan, Apr, Jul & Oct)

10 Implementation

Table 11 details the roles, responsibilities and funding requirements to implement the LWMS.

Any modification required to the LWMS would be identified through the review process of monitoring data and would require the agreement of all parties (DoW, City of Stirling, and developer).

Details of construction and maintenance responsibilities will be appropriately detailed at UWMP stage.

Operation and maintenance of the stormwater management system will initially be the developer’s responsibility, ultimately reverting to the City following handover. Details of maintenance responsibilities will be further outlined at UWMP stage. The schedule for maintenance works will be consistent with typical requirements of the City of Stirling.

Table 11: Implementation Roles & Responsibilities

LWMS Section	Implementation Action	Responsibility & Funding		
		Developer	City of Stirling	DoW
Urban Water Management Plan				
8	Preparation of a UWMP	<input checked="" type="checkbox"/>		
8	Review & Approval of UWMP		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Monitoring Program				
9	Post Development Monitoring Program	<input checked="" type="checkbox"/>		
Stormwater System				
-	Construction of system	<input checked="" type="checkbox"/>		
Operation & Maintenance				
-	a) Prior to Handover	<input checked="" type="checkbox"/>		
	b) Following Handover		<input checked="" type="checkbox"/>	

11 References

Australian and New Zealand Environment and Conservation Council (ANZECC) (2000), National Water Quality Management Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality, October 2000.

City of Stirling (2010), Karrinyup Gwelup Local Area Plan, February 2010.

City of Stirling (2013), City of Stirling Local Planning Scheme No. 3, May 2013.

CMW Geosciences (2015), Proposed Residential Subdivision Lot 2, 455 North Beach Rd, Gwelup, WA, Geotechnical Investigation Report.

Department of Environment (2004a) Acid Sulphate Soil Guideline Series Identification and Investigation of Acid Sulphate Soils, Perth, Western Australia.

Department of Environment (2004b) Perth Groundwater Atlas, Second Edition. Department of Environment, December 2004.

Department of Water (2007), Stormwater Management Manual for Western Australia.

Department of Water (2009a), Decision Process for Stormwater Management in WA.

Department of Water (2009b), Gnangara Groundwater Areas Allocation Plan.

Department of Water (2014a), Perth Groundwater Atlas (online).

Department of Water (2014b), The Water Register: Licence and Water Availability Information (online).

Environmental Protection Authority and Water Authority of WA (1990), Jenny Arnold's Perth Wetlands Resource Book, Bulletin 266 December 1990.

Gozzard (1986), Perth, Sheet 2034 II and Part 2034 III and 2134 III. Perth Metropolitan Regional Environmental Geology Series, Geological Survey of Western Australia.

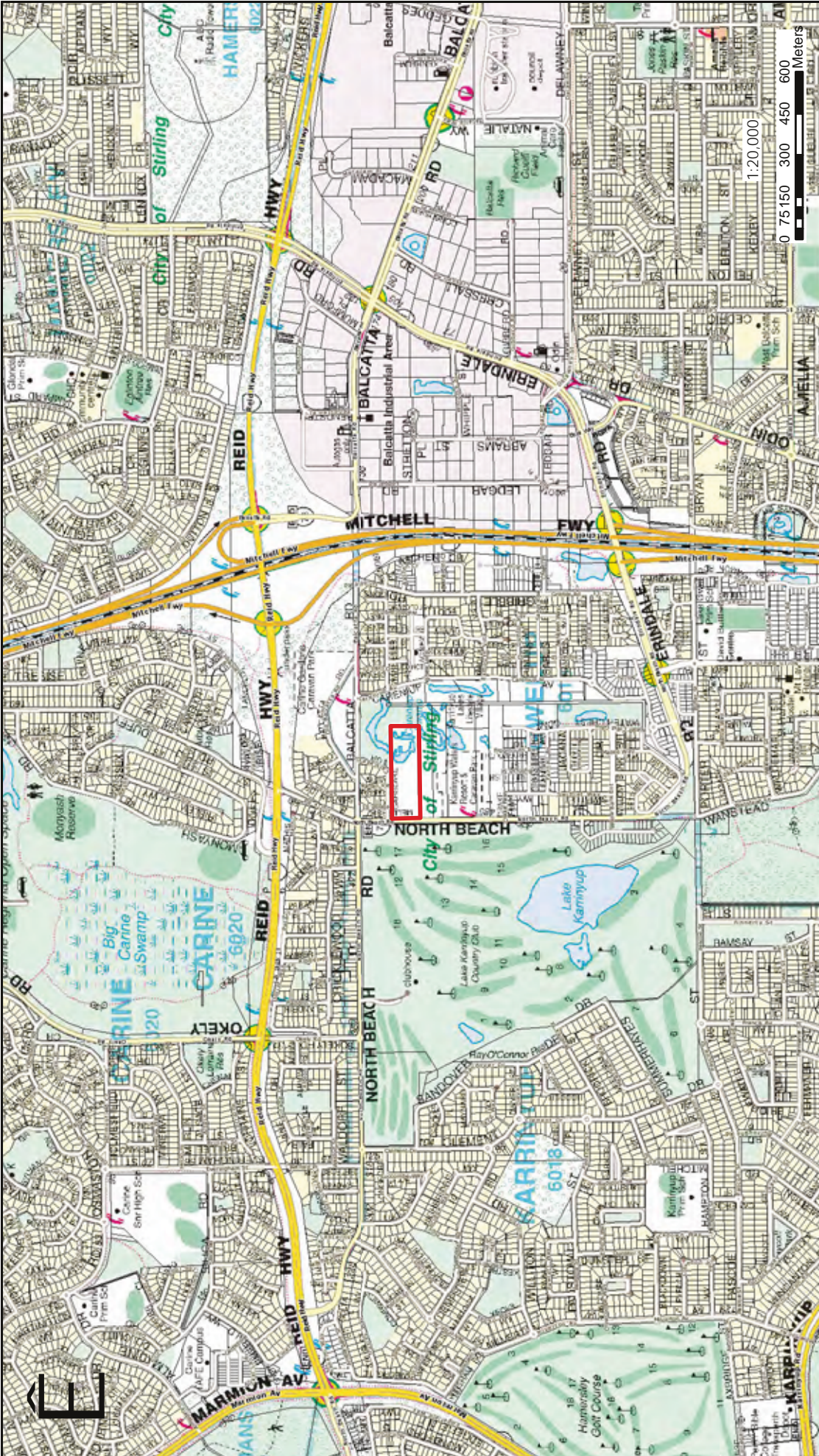
Institution of Engineers Australia (2006), Australian Rainfall Quality.

Institution of Engineers Australia (2000), Australian Rainfall & Runoff.

Western Australian Planning Commission, (2003). Planning Bulletin No. 64: Acid Sulphate Soils. Western Australian Planning Commission, November 2003.

Western Australian Planning Commission. (2008), Better Urban Water Management, October 2008.

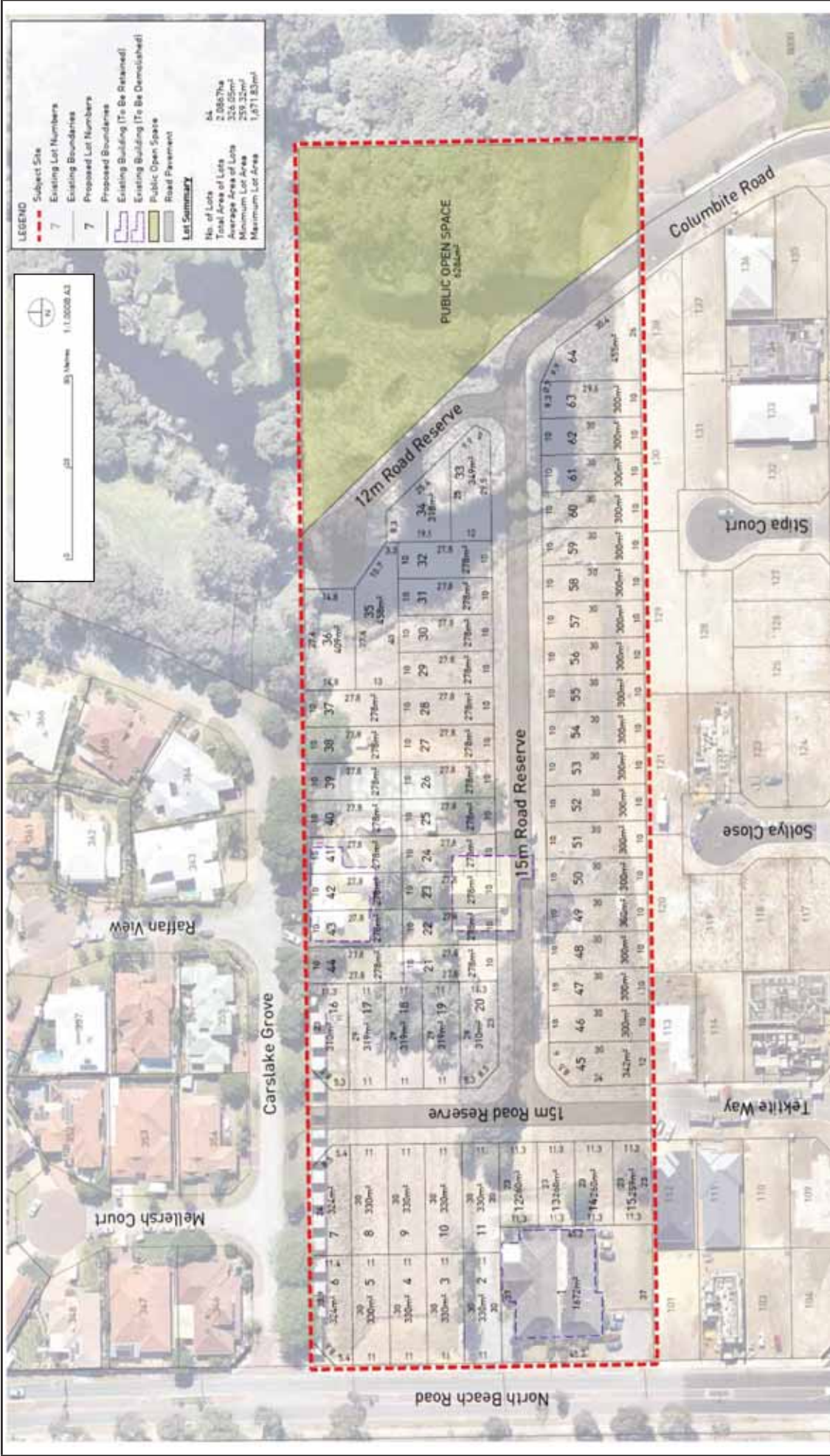
FIGURES



Site



hyd2o
 Lot 2 North Beach Rd Gwelup LWMS
 Location Plan
 Figure 1



Source : The Rowe Group , 2017

hyd2o
 Lot 2 North Beach Rd Gwelup LWMS
 Concept Plan
 Figure 2



Site

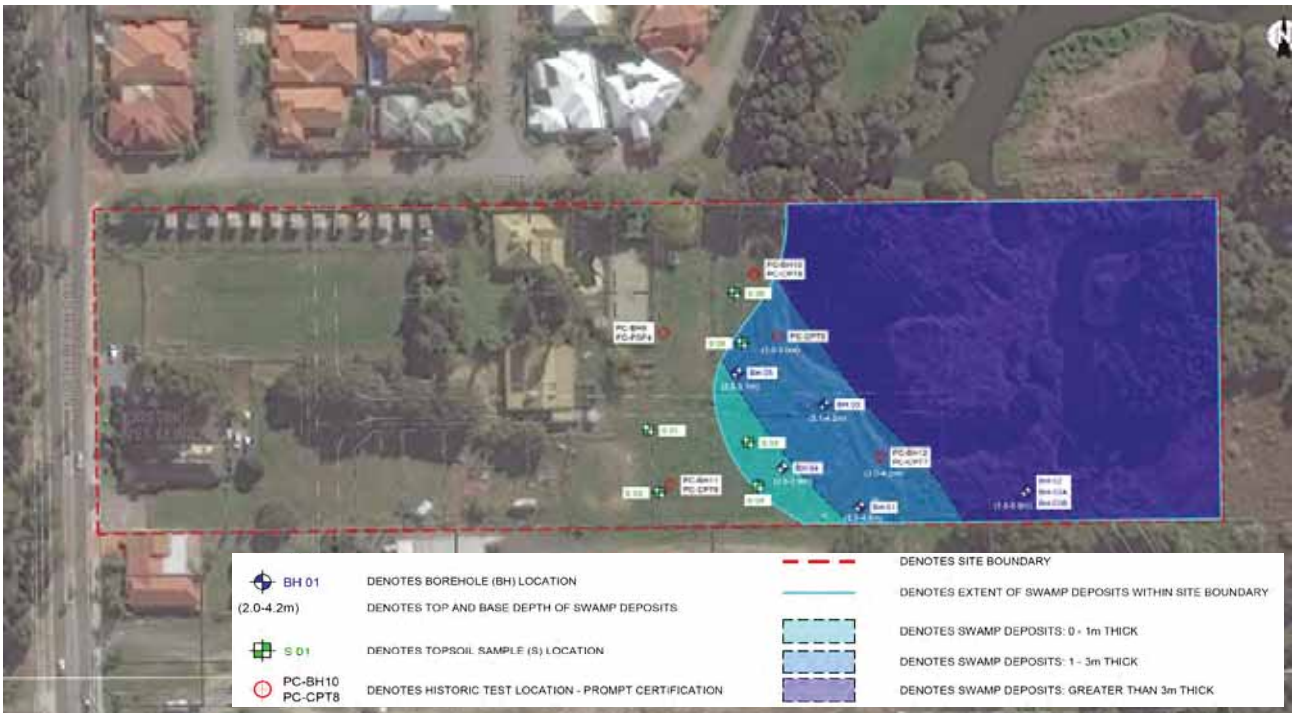
Topographic Contours, m AHD

hyd20

Lot 2 North Beach Rd Gwelup LWMS





Site Conditions

Figure 3

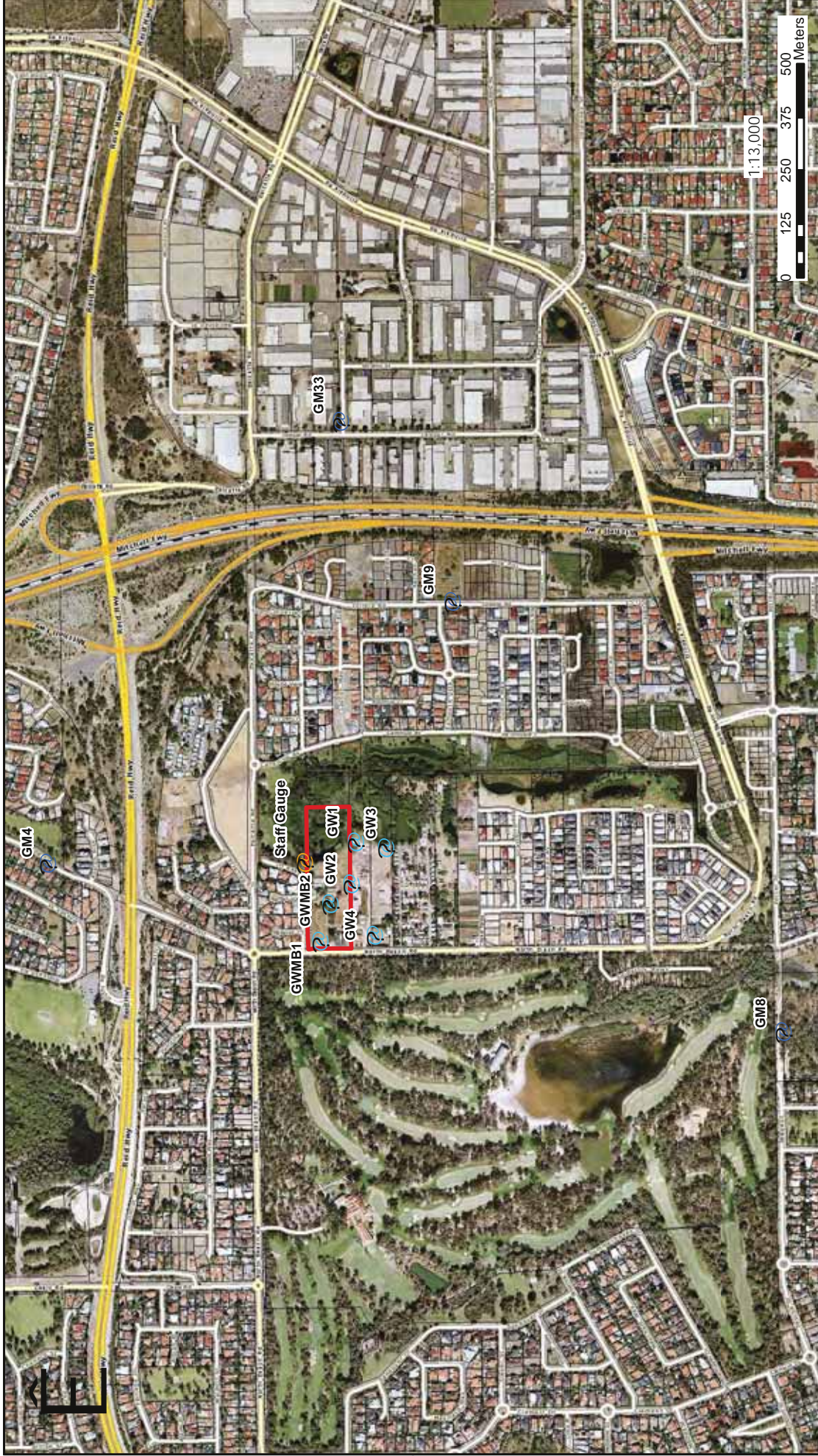


Source: CMW Geosciences (2015)



-  Site
-  Carenjup Swamp Core Area (City of Stirling, 2013)
-  EPP Lakes
-  Resource Enhancement Wetland

hyd20
Lot 2 North Beach Rd Gwelup LWMS
Wetland Plan
Figure 5



Site



DoW Monitoring Bore



DoW Staff Gauge



Hyd2o Monitoring Bores

hyd2o

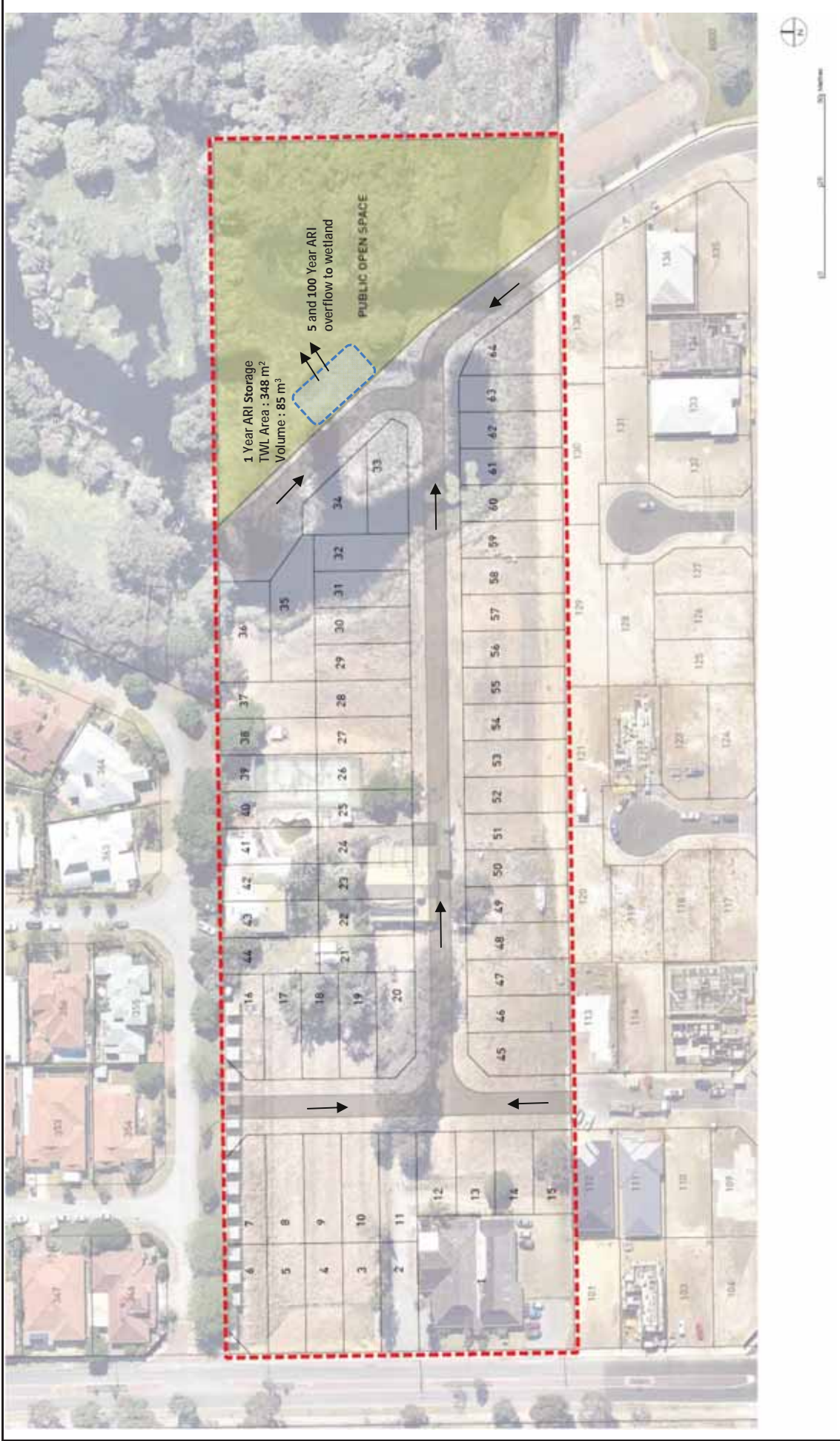
Lot 2 North Beach Rd Gwelup LWMIS

Groundwater Monitoring Locations

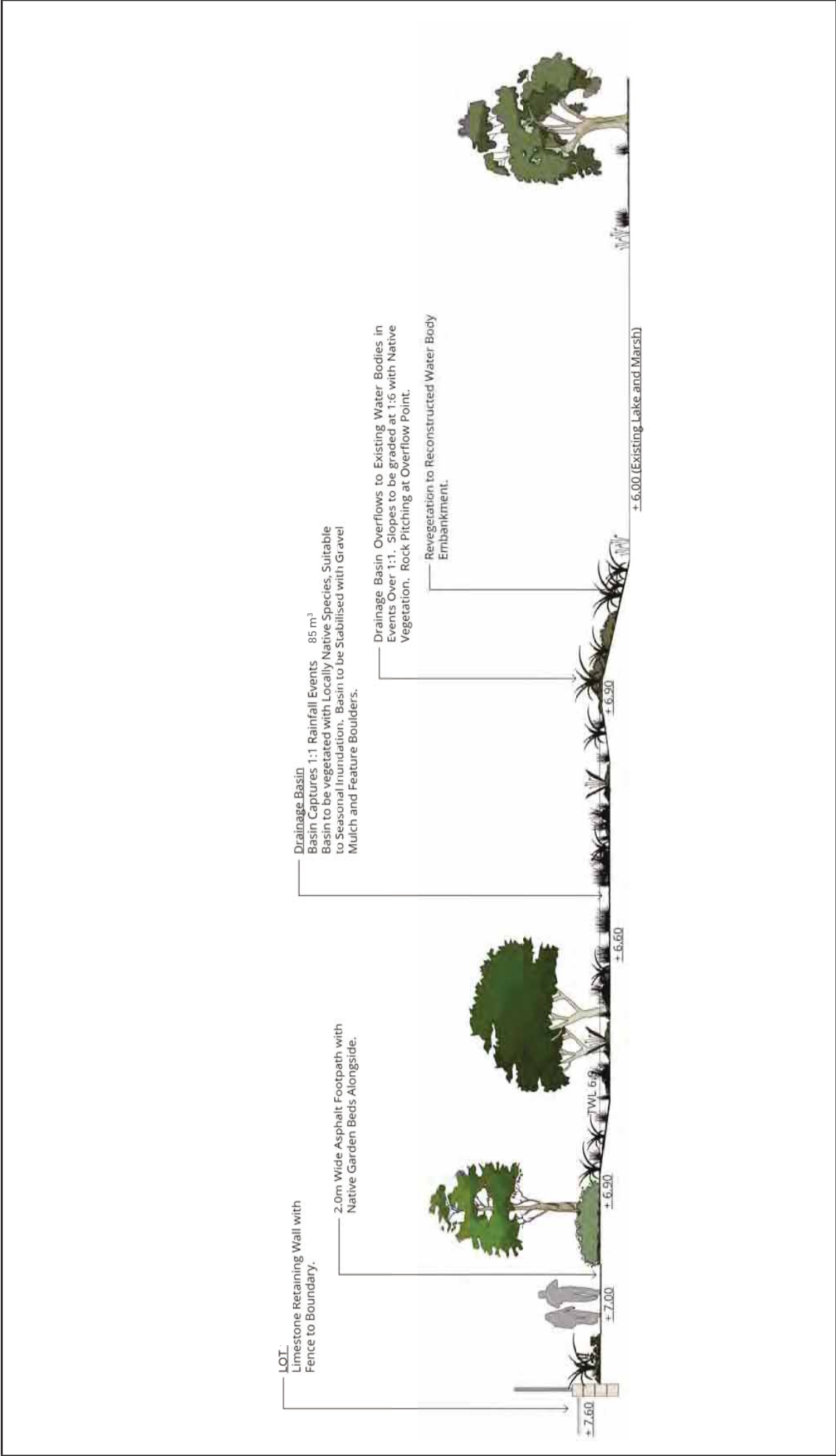
Figure 6



- Site
- AAMGL Contours, m AHD
- DoW Staff Gauge and AAMGL
- Hyd2o Monitoring Bores and AAMGL



Source : The Rowe Group , 2017



hyd₂o
 Lot 2 North Beach Rd Gwelup LWMS
 1 Year ARI Stormwater Cross-Section
 Figure 9

APPENDIX A

LWMS Checklist



LOCAL WATER MANAGEMENT STRATEGY DOCUMENT SUBMISSION CHECKLIST

Document title:	Lot 2 North Beach Rd Gwelup LWMS
Version number:	2 (doc ref : H15006Av2)
Development stage: 1	Number of stages: 1
Associated developments (if relevant):	N/A
Structure plan reference:	
<i>Include structure plan as an appendix</i>	Figure 2 of LWMS
Lots within subject area:	Lot 2
Suburb: Gwelup	
Local Government Authority: City of Stirling	
REQUIRED	CHECK BOX
1 x Hardcopy	X
1 x Electronic copy (CD preferably affixed within CD slip to inside back cover of hard copy)	X
Revised document to include cover letter identifying amendments in relation to comments)	NA
Provide and comply with LWMS Guidelines checklist	X
Referred to Local Government Authority	X
Referred to Department of Parks and Wildlife (if relevant)	NA
Other relevant referrals (list) :	NA
<i>i.e. Swan River Trust, Water Corporation, Dept. Environment & Regulation etc.</i>	
Compiled by (Consultancy):	Hyd2o Hydrology
Contact person: Sasha Martens	Email: sasha@hyd2o.com.au
Contact number: 9382 8683	Postal address: Suite 6b Rokeby Rd Subiaco WA 6008
Project reference number:	H15006
Compiled on behalf of	Owner
Contact person: Darron Baynham	Email: dbaynham@bigpond.net.au
Contact number: 0418 474 644	Postal address: 455 North Beach Rd Gwelup WA 6018

Better Urban Water Management LWMS Checklist

Local Water Management Strategy Item	Deliverable	✓	Comments
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: design elements and requirements for BMP's and critical control points	<input checked="" type="checkbox"/>	Executive Summary and Strategy Table
Introduction			
Total water cycle management - principles and objectives Planning background Previous studies		<input checked="" type="checkbox"/>	Chapter 1
Proposed development			
Structure plan, zoning and land use Key landscape features Previous land use	Site context plan Local structure plan Site conditions plan	<input checked="" type="checkbox"/>	Chapter 2, Figure 1, Figure 2, Figure 3
Landscape - proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Landscape plan	<input checked="" type="checkbox"/>	Landscape Plans to be developed at UWMP Stage and informed by LWMS. Stormwater Areas and Volumes to inform POS credits identified (Figure 9, Chapter 6). Water Availability identified (Section 5.2)
Design criteria			
Agreed design objective and source of objective		<input checked="" type="checkbox"/>	Chapter 4
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		<input checked="" type="checkbox"/>	Chapter 3
Site conditions- existing topography/ contours, aerial photo underlay, major physical features	Site condition plan	<input checked="" type="checkbox"/>	Section 3.1, Figure 3
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical plan	<input checked="" type="checkbox"/>	Section 3.2, Figure 4, Appendix B and C
Environmental- areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Wetland plan plus supporting data where appropriate	<input checked="" type="checkbox"/>	Section 3.3, Figure 5, Appendix D
Surface water- topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface water plan	<input checked="" type="checkbox"/>	Section 3.4, Appendix D
Groundwater - topography, pre development groundwater levels and water quality, test bore locations	Groundwater plan plus details of groundwater monitoring and testing	<input checked="" type="checkbox"/>	Section 3.5, Figure 6 and 7 , Appendices E and F
Water use sustainability initiatives			
Water efficiency measures- private and public open spaces including method of enforcement		<input checked="" type="checkbox"/>	Section 5.1
Water supply (fit- for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance		<input checked="" type="checkbox"/>	Section 5.2
Wastewater management		<input checked="" type="checkbox"/>	Section 5.3
Stormwater management strategy			
Flood protection - peak flow rates, volumes and top water levels at control points, 100 year flow paths and 100 year detentions storage areas	100yr event plan	<input checked="" type="checkbox"/>	Section 6.1, Table 8
Manage serviceability - storage and retention required for the critical 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	5yr event plan	<input checked="" type="checkbox"/>	Section 6.1, Table 8
Protect ecology - detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	1 yr event plan	<input checked="" type="checkbox"/>	Section 6.2, Table 8, Figure 8

Local Water Management Strategy Item	Deliverable	✓	Comments
Groundwater management strategy			
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoil areas/exclusion zones	Groundwater/subsoil Plan	<input checked="" type="checkbox"/>	Section 7.1
Actions to address acid sulphate soils or contamination		<input checked="" type="checkbox"/>	Section 7.2, Figure 4
The next stage - subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design		<input checked="" type="checkbox"/>	Section 8
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		<input checked="" type="checkbox"/>	Section 9, Table 10
Implementation			
Developer commitments		<input checked="" type="checkbox"/>	Chapter 10, Table 11
Roles, responsibilities, funding for implementation		<input checked="" type="checkbox"/>	Chapter 10, Table 11
Review		<input checked="" type="checkbox"/>	Chapter 10, Table 11

APPENDIX B

Hyd2o Lithological Logs

Client : **Serling Consulting**
 Project: **North Beach Rd Gwelup**
 Easting: **385627**
 Northing: **6474359**
 Datum: **MGA Zone 50, GDA 94**
 Drill type: **Drill Rig Hollow Auger**
 Hole diameter: **75 mm**

Job Number : **H15006**
 Start Hole : **9.15 am**
 End Hole : **11.00 am**
 Logged by : **M. Fifield**
 Total Depth : **8.25 m**
 RL Top of Casing : **10.66**
 RL Nat Surface : **10.16**

Bore Name

GWMB1

support	backfill	water	Slot / Screen Depth	Depth (metres)	Soil Characteristics					
					Colour	Particle Size	Texture	Organic Content	Moisture	Comment
PVC (Class 9)	Bentonite			1.0 m	Brown					
				2.0 m	Orange Brown		Sand		Low	
	3.0 m									
	4.0 m			Light Brown						
	5.0 m				Fine		Low			
	6.0 m							Slightly Moist		
	7.0 m									
	8.0 m									
	9.0 m									
	10.0 m									

COLOUR : Black, White, Biege
 Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue
 Composition : Solid , Blemish, Mottle

PARTICLE SIZE : Fine, Medium, Course

TEXTURE : Sand, Loamy Sand, Clayey Sand
 Silt, Loam, Sandy Loam, Clayey Loam
 Clay, Sandy Clay

ORGANICS : High, Medium, Low

MOISTURE : Dry, Slightly Moist, Moist, Saturated

Static Water Level

Date	-
Stickup above NS (m)	-
Water Level bTOC (m)	-
Water Level bNS (m)	-

Client : **Serling Consulting**
 Project: **North Beach Rd Gwelup**
 Easting: **385715**
 Northing: **6474335**
 Datum: **MGA Zone 50, GDA 94**
 Drill type: **Drill Rig Hollow Auger**
 Hole diameter: **75 mm**

Job Number : **H15006**
 Start Hole : **12.00 pm**
 End Hole : **12.45 pm**
 Logged by : **M. Fifield**
 Total Depth : **8.25 m**
 RL Top of Casing : **11.02**
 RL Nat Surface : **10.52**

Bore Name

GWMB2

support	backfill	water	Slot / Screen Depth	Depth (metres)	Soil Characteristics					
					Colour	Particle Size	Texture	Organic Content	Moisture	Comment
PVC (Class 9)	Bentonite	▽		1.0 m	Brown					
				2.0 m		Fine			Low	
	3.0 m			Yellow Brown						
	4.0 m					Sand	Low	Slightly Moist		
	5.0 m							Moist		
	6.0 m			Grey	Medium					
	7.0 m							Saturated		
	8.0 m			Creamy Grey					Variable Limestone Mix	
	9.0 m									
	10.0 m									

COLOUR : Black, White, Biege
 Dark/Medium/Light : Brown, Red, Orange, Yellow, Grey, Blue
 Composition : Solid , Blemish, Mottle

PARTICLE SIZE : Fine, Medium, Course

TEXTURE : Sand, Loamy Sand, Clayey Sand
 Silt, Loam, Sandy Loam, Clayey Loam
 Clay, Sandy Clay

ORGANICS : High, Medium, Low

MOISTURE : Dry, Slightly Moist, Moist, Saturated

Date

Static Water Level

-
-
-

Stickup above NS (m)
 Water Level bTOC (m)
 Water Level bNS (m)

APPENDIX C

Geotechnical Report (Prompt Engineering, 2013)

04 March 2015

**PROPOSED RESIDENTIAL SUBDIVISION
LOT 2, 455 NORTH BEACH ROAD, GWELUP, WA
GEOTECHNICAL INVESTIGATION REPORT**

DARRON BAYNHAM

Ref. 2015-0332AB, Rev0

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Appendix A – Borehole Logs

Appendix B – Laboratory Test Results

1 INTRODUCTION

CMW Geosciences Pty Ltd (CMW) was authorised by Darron Baynham to carry out a geotechnical investigation of a site located at Lot 2, 455 North Beach Road, Gwelup, WA by way of a signed authorisation dated 3 February 2015. The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced 2015-0332AA, Rev0 dated 3 February 2015.

2 BACKGROUND INFORMATION / RELATED REPORTS

A previous geotechnical investigation has been completed at the site by Prompt Certification. The presence of organic material was identified during this investigation in a single location. The investigation presented in this report has been undertaken to further classify risks associated with the proposed development with regard to the organic materials.

Anecdotal evidence suggests that a large volume of the organic material has been quarried from the site by the land owner and uncontrolled fill material has been put in its place. The exact extents of this operation are not clear.

3 SCOPE OF WORK

As detailed in our proposal letter, the instructed scope of work to be conducted by CMW was defined as follows:

- Gain a better understanding of the extent of peat deposits;
- Gain a better understanding on potential to obtain AS2870 Class A holistically;
- Obtain an understanding of the requirements to blend the topsoil for use on site;
- Determine the relevance of the use of dynamic compaction methods to reclaim the wetlands areas;
- Compile all of the above detail into a concise geotechnical investigation report, incorporating relevant plans, field investigation data and laboratory test data for the remediation of the organic materials.

It must be noted that our scope of work is limited to providing recommendations for the remediation of the eastern end of the site only, where the organic materials are present.

4 SITE DESCRIPTION

The proposed development site comprises an area of approximately 3.34 Ha and is located at Lot 2, 455 North Beach Road, Gwelup, WA as shown on the attached Site Location Plan – Figure No. 1.

The site grades gently from approximately RL13m AHD on the western boundary to RL7m AHD within the lower lying swamp lands at the eastern end of the site. It is bound to the west by North Beach Road, to the east by Careniup Avenue and to the north and south by semi-rural properties.

Uncontrolled fill containing construction rubble is present on the surface within the eastern portion of the site which we understand was placed following large cut works. The majority of the site is covered in vegetation comprising grass paddocks, large trees and shrubs. The eastern portion of the site is dominated by swamp vegetation including long grass and large trees. A veterinary clinic is present along the western boundary of the site with a residential house and shed occupying the centre of the lot.

5 PROPOSED DEVELOPMENT

The preliminary construction plans show that the proposed development comprises forty four R25 green titles, a R40 grouped development site and a mixed use/commercial site with associated roads and access ways.

6 FIELD INVESTIGATION

6.1 Previous Investigations

The site was previously investigated by Prompt Certification for the current client. The scope of fieldwork completed was as follows:

- Drilling of twelve boreholes to depths of 2.5m;
- Completing four Perth Sand Penetrometer Test (PSP) to depths of 2.0m;
- Advancing of nine Cone Penetrometer (CPT) Tests to depths of up to 10.0m; and
- Seismic surveying including GPR.

The locations relevant to our investigation and scope of work are also shown on Figure 02.

6.2 Current Investigation

Following a dial before you dig search, and onsite service location, the field investigation was carried out on 9 February 2015. All fieldwork was carried out under the direction of CMW Geosciences Pty Ltd in general accordance with AS1726 (1993), Geotechnical Site Investigations. The scope of fieldwork completed was as follows:

- Undertake a walkover survey of the site to assess the general landform, site conditions and adjacent structures / infrastructure;
- Seven machine boreholes, denoted BH01, BH02, BH02A, BH02B and BH03 to BH05, were advanced using direct push techniques to depths of up to 6.0m to determine a ground model, placing particular emphasis on outlining the depth, thickness and extent of swamp deposits. Representative bulk samples were collected at selected depths to provide samples for subsequent laboratory testing. Engineering logs of the boreholes are provided in Appendix A; and
- Seven hand dug test pits, denoted TS01 to TS07, were completed to depths of up to 0.20m to obtain topsoil samples for laboratory testing.

The approximate locations of the respective investigation sites referred to above are shown on the attached Site Plan (Figure No. 02).

7 LABORATORY TESTING

Laboratory testing was carried out generally in accordance with the requirements of the current edition of AS 1289 (where applicable). Where a test was not covered by an Australian standard, a local or International standard was adopted and noted on the laboratory test certificate.

All testing was scheduled by CMW and carried out by Mining and Civil Geotest and Cardno, NATA registered Testing Authorities.

The extent of testing carried out to provide the geotechnical parameters required for this study are presented in Table 1.

Type of Test	Test Method	Quantity
Particle size distribution	AS1289.3.6.1	5
Atterberg Limits	AS1289.3.1.1, 3.2.1, 3.3.1	5
Consolidation tests	AS1289.6.6.1	2
Organic tests	ASTM: D2974-07a Test Method C	14
Percentage fines	AS1289.3.6.1	2

Certificates for the test results outlined above are presented in Appendix B.

8 GROUND MODEL

8.1 Geology

Published geological maps (*Sheet 2034 Part II and Part of Sheet 2034 III and 2134 III*) and the CMW investigation database for the area depict the western portion of the site as being underlain by sands derived from Tamala Limestone (S₇) with Peaty Clay Deposits (Cps) occurring towards the east of site.

8.2 Subsurface Conditions

The initial investigation undertaken by Prompt Certification identified the presence of peaty clay within a single borehole and a single CPT location in the eastern end of the site. Our investigation was undertaken specifically to further identify the presence, nature and extent of this material. The subsurface profile provided below is specifically for the area containing this material (eastern end) and does not consider the remainder of the site, which is covered by the previous investigation report.

TOPSOIL	silty sand, black grass cover and 100 mm root zone;
FILL SAND	brown to grey brown, fine to coarse grained, trace gravel;
SAND	medium dense, light brown and orange, medium to coarse grained sand;
ORGANIC CLAYEY SAND	loose, dark brown to black, medium to high plasticity (Swamp Deposits);
ORGANIC CLAY	very soft, black to dark brown, high plasticity (Swamp Deposits);
SAND	medium dense, pale grey brown, fine to coarse grained sand

The distribution of these units is summarised in Table 2 below.

Description	Depth to bottom of layer (m)		
	Minimum	Maximum	Average
TOPSOIL / SAND	0.1	0.2	0.15
FILL SAND	1.0	2.5	1.8
SAND	2.5	3.1	2.8
ORGANIC CLAYEY SAND (Swamp Deposits)	2.9	4.2	3.4

ORGANIC CLAY* (Swamp Deposits)	5.0	5.0	5.0
SAND	>6.0		
Notes: * Strata only encountered in BH02 and BH02A ** Base of strata not encountered			

Figure 02 gives a visual representation of the extent of the Swamp Deposit materials and Figure 03 provides a cross section across the eastern side of the site.

8.3 Laboratory Test Results

8.3.1 Classification Tests

Results of the classification laboratory tests are summarised in Table 3 below:

Test Location	Depth (mbgl)	Gravel (%)	Sand (%)	Fines (%)	LL (%)	PL (%)	PI (%)	LS (%)	OC (%)
BH01	2.50 – 3.00	3	74	23	SIC	NP	NP	1.5	83
BH01	3.00 – 4.00	23	46	31	-	-	-	-	21
BH02	1.30 – 1.50	-	-	-	-	-	-	-	18
BH02	2.70 – 3.00	-	-	-	-	-	-	-	9.7
BH02A	1.50 – 1.70	6	63	31	-	-	-	-	14
BH02A	3.00 – 4.00	0	34	76	104	69	35	9.5	9.1
BH02A	3.00 – 3.50	-	-	2	NP	NP	NP	0.0	-
BH02B	3.00 – 3.50	-	-	6	NP	NP	NP	0.0	-
BH03	3.10 – 4.20	2	87	11	SIC	NP	NP	0.0	23
TS01	0.00 – 0.20	-	-	-	-	-	-	-	3.6
TS02	0.00 – 0.20	-	-	-	-	-	-	-	5.1
TS03	0.00 – 0.20	-	-	-	-	-	-	-	6.0
TS04	0.00 – 0.20	-	-	-	-	-	-	-	6.2
TS05	0.00 – 0.20	-	-	-	-	-	-	-	12
TS06	0.00 – 0.20	-	-	-	-	-	-	-	1.9
TS07	0.00 – 0.20	-	-	-	-	-	-	-	3.1

Note: Gravel, sand and fines percentages are by weight, LL = liquid limit, PL = plasticity limit, PI = plasticity index, LS = linear shrinkage, NO = Not obtainable, NP = Non Plastic, SIP = Slipped in Cup, OC = Organic Content

8.3.2 Consolidation Tests

The consolidation tests were undertaken on undisturbed samples obtained from the boreholes. The results of the testing are shown in detail in Appendix B. In this instance, the oedometer analyses have been undertaken on samples of clayey sand. No samples of the clay deposit were obtainable during this investigation. However, E' values derived from the consolidation tests indicate approximately 5-10 MPa, which is typical of very loose clayey sands.

8.4 Groundwater

The Perth Groundwater Atlas suggests groundwater levels seasonally vary from approximately RL5m AHD to RL11m AHD. These levels equate to depths of approximately 1.0m to 1.5m below existing ground levels.

Groundwater was encountered at a depth of approximately 1.5m during the investigation which corresponds to the approximate lake groundwater level. It should be noted that the investigation was undertaken during Summer months and groundwater levels will be higher after periods of heavy rainfall.

9 GEOHAZARDS

9.1 Soft / Loose Ground

The eastern end of the site contains very soft organic clays and very loose to loose clayey sands (Swamp Deposits). These deposits are susceptible to significant consolidation settlement under only minor increases in applied pressure. Settlements are likely to occur over a significant time period (several years) which presents potential issues for future movement sensitive structures such as services, buildings and pavements.

Based on the investigation results, up to 3.5m of these Swamp Deposit sediments were encountered beneath the proposed building platform. Consolidation settlements associated with the proposed earthfill loads, together with long term creep settlements, have been calculated to exceed normal building tolerances.

As an alternative to excavation and replacement, ground improvement, in the form of wick drains and the construction of temporary surcharge embankments is often the most cost effective solution to over-consolidate the weak sediments and reduce total and differential settlement magnitudes beneath future structures. Further specific details and anticipated results are provided in Section 12 below.

10 GEOTECHNICAL DESIGN PARAMETERS – SWAMP DEPOSITS

A description of the geotechnical properties and recommended preliminary design parameters for the Swamp Deposits encountered is provided below. These parameters have been determined based on the data obtained from the geotechnical investigations completed, published information and our experience of this material. The Swamp Deposits are assumed to be normally to near normally consolidated and the clay layers have high plasticity and a high liquid limit. It is very soft clay material with low undrained shear strength and typically 9% to 23% organic material.

A summary of the laboratory testing results undertaken on limited representative samples are as follows:

- fines content of clayey sand typically around 24% and range from 11% to 31%;
- fines content of clay layer is 76%
- organic content typically between 9% and 23%, but as high as 83%;
- liquid limit of clay layers 104%
- plasticity index of clay layer 35%

Table 4 below provides the preliminary values used for the Swamp Deposits. It must be noted that the Swamp Deposits are highly variable and the parameters below have been selected based on an assessment of the behavior of the material as a single unit.

Table : Summary of Geotechnical Design Parameters for Swamp Deposits	
Parameter	Value
Saturated density, γ	17 kN/m ³
Drained angle of internal friction, ϕ'	25 ^o
Undrained shear strength, c_u	5 kPa
Over consolidation ratio (OCR)	1
Initial void ratio e_0	1.0
Compression index, C_c	0.4
Secondary compression index, C_{α}	0.045
Coefficient of vertical consolidation, C_v	1 m ² /yr
Coefficient of horizontal consolidation, C_h	4 m ² /yr
Poisson's ratio, ν	0.2 (drained), 0.5 (undrained)
Hydraulic conductivity, k	0.01 m/day

11 CONSTRUCTION RECOMMENDATIONS AND REMEDIATION

11.1 Mitigation of Ground Settlements -Remediation

11.1.1 General

Given the characteristics of the organic clayey material, as described above, significant short and long term settlement is expected to occur in response to the fill placement for the proposed development.

In order to reduce settlements to tolerable limits, remediation of the Swamp Deposits is required.

The recommended option of remediation is the use of wick drains and surcharge to consolidate this material prior to development. An alternative solution would be to remove this material from site and replace with imported granular fill. However, significant dewatering and removal costs, coupled with potential environmental issues with Acid Sulfate Soils may make this option uneconomical.

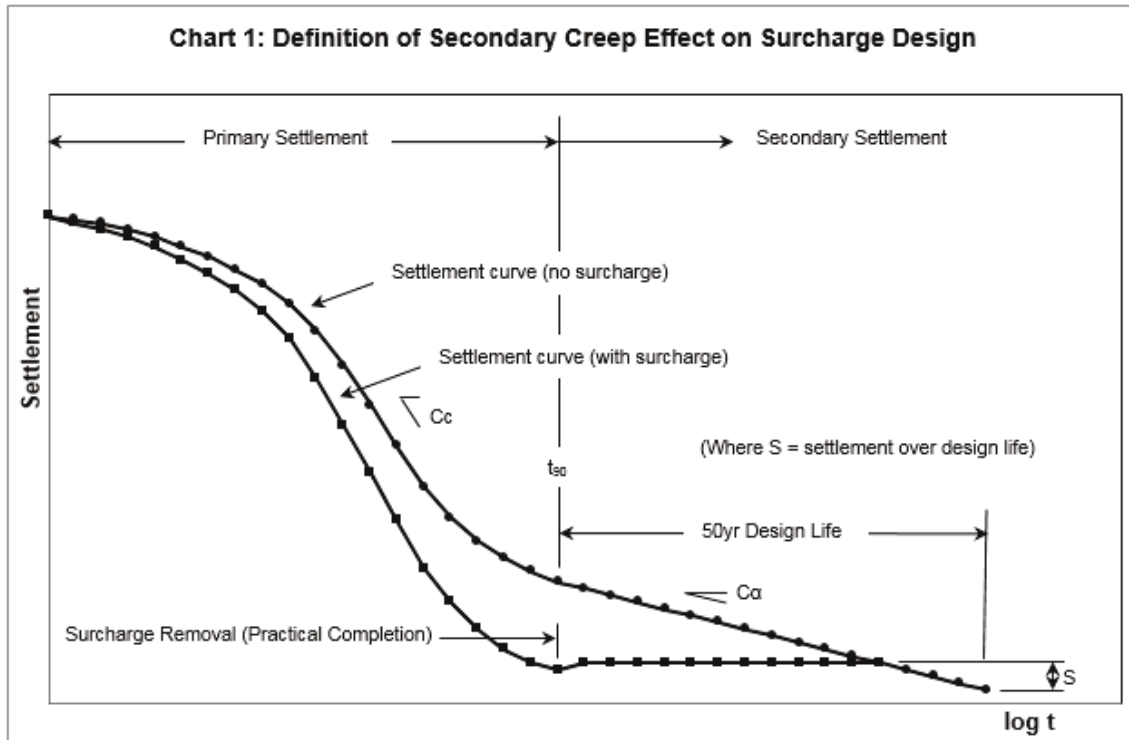
11.1.2 Surcharge Requirements

Surcharging consists of placing temporary fill embankments to a height that exceeds the design finished surface level. The embankments are then subsequently cut back to the design level following a suitable period of consolidation settlement. The purpose of the surcharging is to ensure that:

- The magnitude of load applied to the organic layers by surcharging is greater than the design in-service loading thereby ensuring a stiffer reloading response;
- Adequate unloading is achieved following surcharging so that the over-consolidation ratio of the material is increased sufficiently to reduce post construction creep settlements to be within typical performance criteria over the design life of the development.

Surcharge embankment design must consider both primary consolidation settlement and secondary compression (creep) settlement to ensure that post construction creep settlements, following surcharge removal, are within specified performance criteria.

The design theory for surcharging can be illustrated on the simplified diagrammatic chart in Chart 1 below. It is noted that the shape of the post surcharge settlement curve has been modified from the actual curved Mesri relationship for simplicity and illustrative purposes only.



Conventional theoretical methods should be used to calculate primary settlements using one-dimensional methods and secondary creep settlements estimated in accordance with the method described by Mesri et al (1994) using the soil parameters provided in Section 11. These approaches are governed by the parameters of the surcharge fill and the Swamp Deposits as well as the thickness of the layers and the groundwater level.

As a preliminary guide, based on a design life of the development of 40 years, up to approximately 5.5m surcharge height is estimated to be required (for a Swamp Deposit material thickness of 3.5m) in order to limit future fill settlements to less than 25mm. The surcharge height will be less where the thinner swamp deposits are present (Refer to Figures 02 and 03).

11.1.3 Time Rate of Settlement

Surcharging is typically carried out to achieve 90% of the design consolidation settlement, referred to as t_{90} , during the surcharge period. Based on the parameters of the material, as described in Section 11, it has been calculated that t_{90} would take many years to occur unless suitable measures are adopted.

To accelerate the rate of primary consolidation, prefabricated vertical drains (PVD) or wick drains are typically installed to shorten the drainage path lengths and take advantage of the higher horizontal soil permeability that is often evident. The wick drains typically comprise a corrugated core through which water can flow, with a permeable geotextile outer cover. The drains are usually installed using a push in mandrel.

The time required for the Swamp Deposits to reach 90% of its primary consolidation may be estimated using empirical equations. Assuming wick drains that are 100mm wide and 10mm thick and installed on a triangular grid pattern, the spacing's and t_{90} times shown in Table 5 below are obtained.

Triangular Grid Spacing (m)	0.9	1.1	1.3	1.5
t ₉₀ (days)	163	250	358	486

The following assumptions have been made:

- A smear zone diameter of 0.35m for each wick drain has been assumed, this being equal to 5 times the effective diameter of the wick drain;
- The geotechnical properties and parameters of the Swamp Deposits as previously defined; and
- A k_h/k_s ratio of 4 has been assumed, where k_h is the horizontal permeability of the Swamp Deposits and k_s is the permeability of the smear zone, also being equivalent to the vertical permeability of the Swamp Deposits.

11.2 Earthworks

Bulk earthworks are required to reach design finished ground surface level, although design levels were unknown at the time of preparing this report.

Recommendations associated with this work are summarised as follows:

- Removal of all vegetation and associated root mats to a depth of approximately 200mm;
- Based on the organic content results of the topsoil testing, the underlying black sand may be blended with clean granular fill material as specified below at a ratio of approximately 3 (clean imported sand) to 1 (topsoil sand);
- All imported fill material required for permanent fill construction or temporary surcharge embankment construction must comprise clean sand fill to meet a grading criteria as follows:
 - It is of a clean granular nature with less than 15% fines content. Where it has a fines content of greater than 15%, it may still be suitable for reuse as an engineered fill material subject to more stringent moisture content controls and use only in suitable (dry) weather conditions;
 - It is free from boulders or particles larger than 150mm and is free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials.
- All permanent fill materials must be moisture conditioned to within $\pm 3\%$ of the optimum moisture content, placed and compacted in layers with a suitable roller to achieve a dry density ratio of at least 95% based on Modified compaction (AS1289 5.2.1).
- All surcharge fills must be moisture conditioned and compacted to achieve a unit weight that is consistent with the specified surcharging design requirements.

The technical and control requirements for Engineered Fill, including site observation and compaction testing, are outlined in AS3798. We recommend that this work, and in particular, determining the depth and extent of any Uncontrolled Fill removal during site earthworks, is completed under the direction and control of a suitably experienced Geotechnical Engineer familiar with the contents of this report. CMW would be pleased to perform this function if required.

11.3 Site Classification

As described above, the site classification provided herein is limited to the eastern side of the site where Swamp Deposits are present. In this area, a Class P classification to AS 2870 is applicable due to the presence of deep soft soils and significant ground movements. The extent of these deposits are shown on Figure 02.

However, if the remediation recommendations provided herein are carried out, the site may be designed as equivalent to Class A, subject to adequate performance specifications (settlement requirements) during the design stages.

12 FURTHER WORK

12.1 Investigation

Currently, no information exists with regard to the depth and thickness of the organic soils beneath the lake. In order to confirm design assumptions and ensure an accurate surcharge design, it is recommended that additional investigation be undertaken within this area.

12.2 Detailed Design

Detailed design of the surcharge heights and wick drain spacing must be carried out for this development by a suitably qualified geotechnical engineer familiar with the contents of this report. CMW would be pleased to undertake this work.

12.3 Monitoring

Monitoring of the works is required in order to assess whether the ground improvement and earthworks is being carried out and responding in accordance with the design expectations.

As an initial guide it is recommended that settlement survey plates are installed at the base of surcharge embankments to monitor time settlement trends with respect to design expectations.

The results of all instrumentation monitoring must be collected at regular intervals and assessed with respect to design criteria.

13 CLOSURE

The findings contained within this report are the result of limited discrete investigations conducted in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, can it be considered that these findings represent the actual state of the ground conditions away from our investigation locations.

If the ground conditions encountered during construction are significantly different from those described in this report and on which the conclusions and recommendations were based, then we must be notified immediately.

This report has been prepared for use by Darron Baynham in relation to the 455 North Beach Road, Gwelup project in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than Darron Baynham and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

**For and on behalf of
CMW Geosciences Pty Ltd**



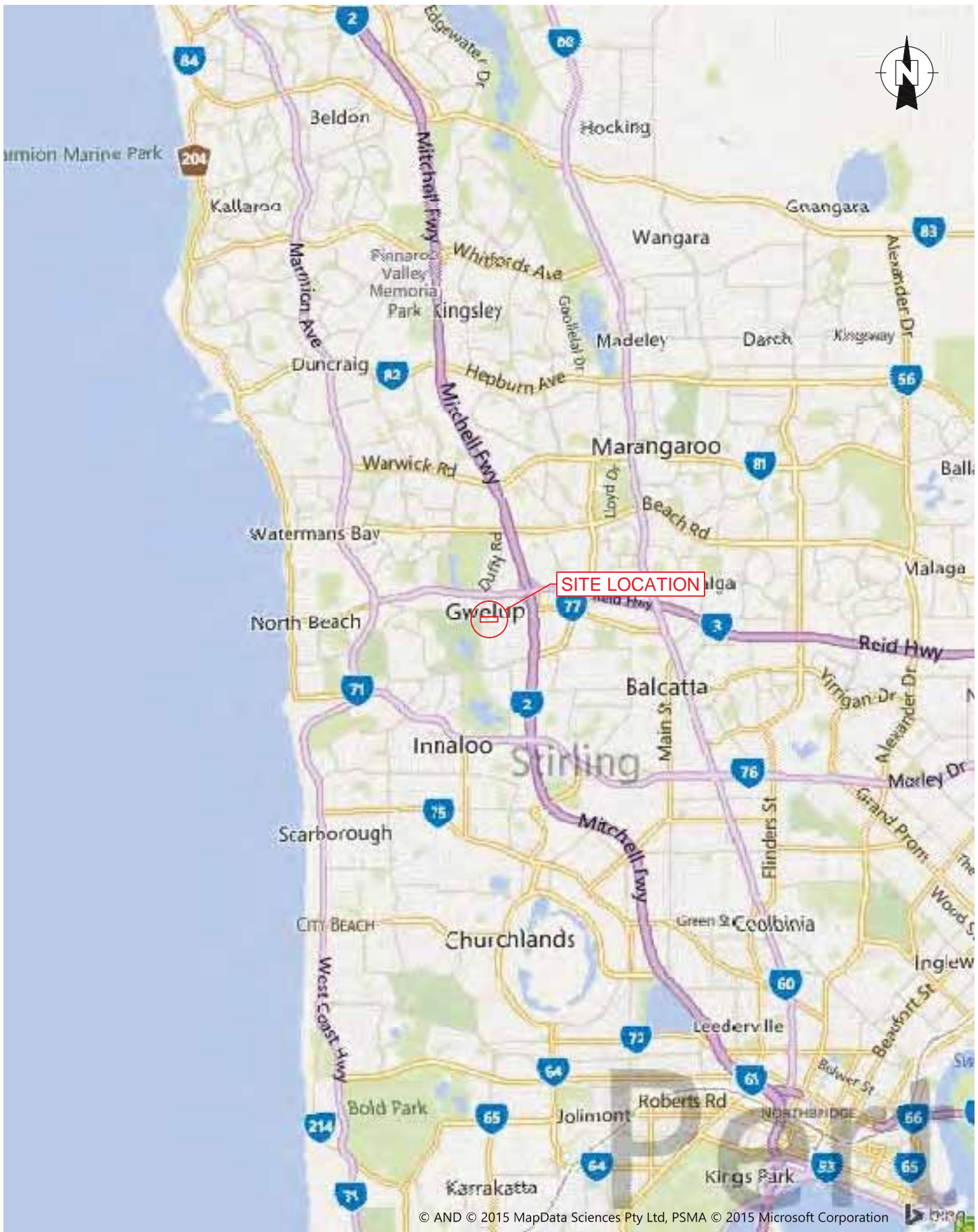
Alex Petty
Senior Geotechnical Engineer



Craig Butterworth
Director / Principal Geotechnical Engineer

Distribution: 1 copy to Darron Baynham (electronic)
Original held by CMW Geosciences Pty Ltd

Figures



0 1 2 3 4 5 km

1:100 000



CLIENT:	SERLING CONSULTING PTY	DRAWN:	CJ	PROJECT:	2015-0332
PROJECT:	455 NORTH BEACH ROAD GWELUP, WA	CHECKED:	ACE	FIGURE:	01
TITLE:	SITE LOCATION PLAN	REVISION:	0	SCALE:	1:100 000
		DATE:	17/02/2015	SHEET:	A4 P



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NOTE: BASE PLAN ADAPTED FROM: TABEC CIVIL ENGINEERING, SEWER RETICULATION PLAN, DRAWING NUMBER: 2324-01-201, REV. A



PROJECT:	2015-0332
CLIENT:	SERLING CONSULTING PTY
PROJECT:	455 NORTH BEACH ROAD GWELLUP, WA
TITLE:	SITE INVESTIGATION PLAN

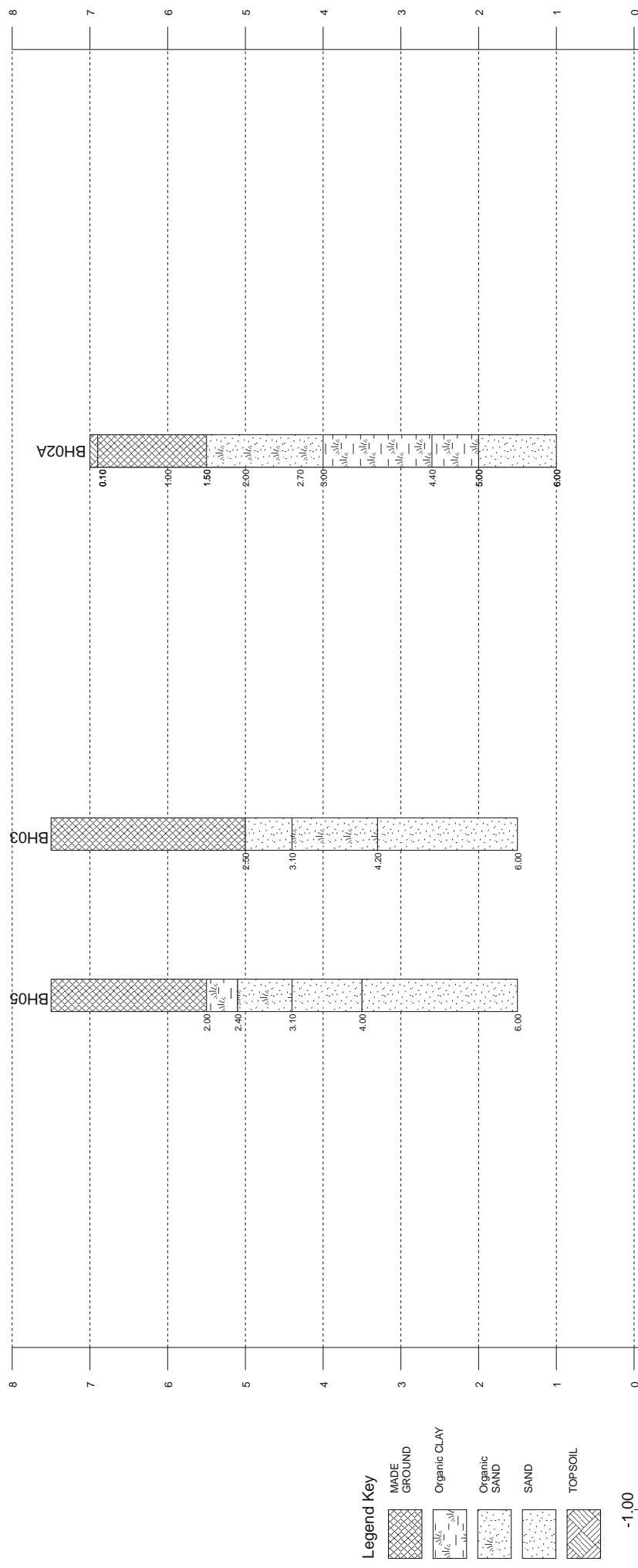
DRAWN:	CJ
CHECKED:	ACE
REVISION:	0
DATE:	17/02/2015



	DENOTES SITE BOUNDARY
	DENOTES EXTENT OF SWAMP DEPOSITS WITHIN SITE BOUNDARY
	DENOTES SWAMP DEPOSITS: 0 - 1m THICK
	DENOTES SWAMP DEPOSITS: 1 - 3m THICK
	DENOTES SWAMP DEPOSITS: GREATER THAN 3m THICK

	DENOTES BOREHOLE (BH) LOCATION
	DENOTES TOP AND BASE DEPTH OF SWAMP DEPOSITS
	DENOTES TOPSOIL SAMPLE (S) LOCATION
	DENOTES HISTORIC TEST LOCATION - PROMPT CERTIFICATION

	BH 01 (2.0-4.2m)
	S 01
	PC-BH10 PC-CPT8



Chainage (m)	0.00	128.78	167.07
Offset (m)	15.20	13.77	
Elevation (mAOD)	7.50	7.00	

Appendix A

Machine Borehole Logs

BOREHOLE LOG - BH01

Client: Serling Consulting
 Project: 455 North Beach Road
 Location: Gwelup, WA
 Project ID: 2015-0332
 Date: 09/02/2015



Sheet 1 of 1

Logged By: ACE
 Checked By:

Position: E.385833m N.6474291m
 Elevation:

Hole Diameter: 63mm
 Angle from Horizontal: 90°

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristic; Colour, Secondary and Minor Components	Moisture Condition	Consistency	Relative Density	Structure & other observations
		Depth	Type & Results								
					0		FILL - SAND: fine to medium grained, grey-brown; trace cement fines; trace fine grained gravel, of limestone.				
					1		FILL - SAND: medium to coarse grained, brown to dark brown; trace fine grained gravel, of cemented sand; trace fines; with cemented sand layers.				
		2.50 - 3.00	B		2		...from 2.40m to 2.50m, cemented sand/ limestone layer.				
		3.00 - 4.00	B		3		SC: Organic CLAYEY SAND: fine to coarse grained, black; clay, medium plasticity, with roots and root fibres. Behaves cohesively.				Possible reworked ground.
					4		SP: SAND: fine to coarse grained, pale grey-brown; trace fines.				
					5						
					6		End of borehole at 6.00 m				
					7						
					8						
					9						
					10						

Termination Reason: Target Depth
 Remarks:

BOREHOLE LOG - BH02

Client: Serling Consulting
 Project: 455 North Beach Road
 Location: Gwelup, WA
 Project ID: 2015-0332
 Date: 09/02/2015



Sheet 1 of 1

Logged By: ACE
 Checked By:

Position: E.385882m N.6474295m
 Elevation:

Hole Diameter: 63mm
 Angle from Horizontal: 90°

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristic; Colour, Secondary and Minor Components	Moisture Condition	Consistency	Relative Density	Structure & other observations
		Depth	Type & Results								
					0	TOPSOIL - CLAYEY SAND: fine to medium grained, dark brown; clay, low plasticity (15-20%); with roots and root fibres. FILL - SAND: fine to medium grained, brown to grey-brown; with fines; trace fine grained gravel.	M				
		1.10 - 1.30	B		1	SC: Organic CLAYEY SAND: fine to coarse grained, black; clay, medium plasticity, with roots and root fibres. Behaves cohesively.	VS				U-tube recovered no sample. Inferred as sand.
		1.50 - 2.00	UT		2						
		2.70 - 3.00	B		3	OH: Organic CLAY: medium to high plasticity, grey; trace sand; with roots and root fibres; organic odour.	W				
		3.00 - 3.50	UT		4						
					5	SP: SAND: medium to coarse grained, grey-brown; trace fines.	VS				
					6	End of borehole at 6.00 m					
					7						
					8						
					9						
					10						

Termination Reason: Target Depth
 Remarks:

BOREHOLE LOG - BH02A

Client: Serling Consulting
 Project: 455 North Beach Road
 Location: Gwelup, WA
 Project ID: 2015-0332
 Date: 09/02/2015



Sheet 1 of 1

Logged By: ACE
 Checked By:

Position: E.385882m N.6474295m
 Elevation:

Hole Diameter: 50mm
 Angle from Horizontal: 90°

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristic; Colour, Secondary and Minor Components	Moisture Condition	Consistency	Relative Density	Structure & other observations
		Depth	Type & Results								
		1.50 - 1.70	B		1	<p>TOPSOIL - CLAYEY SAND: fine to medium grained, dark brown; clay, low plasticity (15-20%); with roots and root fibres. FILL - SAND: fine to medium grained, brown to grey-brown; with fines; trace fine grained gravel.</p>	M				
		3.00 - 4.00	B		2	<p>SC: Organic CLAYEY SAND: fine to coarse grained, black and grey; clay, medium plasticity, with roots and root fibres. Organic Odour. Behaves cohesively.</p>					
					3	<p>OH: Organic CLAY: medium to high plasticity, grey; trace sand; with roots and root fibres; organic odour.</p>	VS				
					4	<p>OH: Organic CLAY: medium to high plasticity, black; with roots and root fibres; trace sand.</p>	W				
					5	<p>SP: SAND: medium to coarse grained, grey-brown; trace fines.</p>					
					6	<p>...from 5.70m, pale grey-brown.</p> <p>End of borehole at 6.00 m</p>					

Termination Reason: Target Depth
 Remarks:

BOREHOLE LOG - BH02B

Client: Serling Consulting
 Project: 455 North Beach Road
 Location: Gwelup, WA
 Project ID: 2015-0332
 Date: 09/02/2015



Sheet 1 of 1

Logged By: ACE
 Checked By:

Position: E.385882m N.6474295m
 Elevation:

Hole Diameter: 50mm
 Angle from Horizontal: 90°

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristic; Colour, Secondary and Minor Components	Moisture Condition	Consistency	Relative Density	Structure & other observations
		Depth	Type & Results								
		1.50 - 2.00	UT		1		TOPSOIL - CLAYEY SAND: fine to medium grained, dark brown; clay, low plasticity (15-20%); with roots and root fibres. FILL - SAND: fine to medium grained, brown to grey-brown; with fines; trace fine grained gravel.	M			
					2		SC: Organic CLAYEY SAND: fine to coarse grained, black; clay, medium plasticity, with roots and root fibres. Behaves cohesively.	W		VS	
End of borehole at 2.00 m											
					3						
					4						
					5						
					6						
					7						
					8						
					9						
					10						

Termination Reason: Target Depth
 Remarks:

BOREHOLE LOG - BH03

Client: Serling Consulting
 Project: 455 North Beach Road
 Location: Gwelup, WA
 Project ID: 2015-0332
 Date: 09/02/2015



Sheet 1 of 1

Logged By: ACE
 Checked By:

Position: E.385822m N.6474323m
 Elevation:

Hole Diameter: 50mm
 Angle from Horizontal: 90°

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristic; Colour, Secondary and Minor Components	Moisture Condition	Consistency	Relative Density	Structure & other observations
		Depth	Type & Results								
	M	3.10 - 4.20	B		0		FILL - SAND: fine to medium grained, grey-brown; trace fine grained gravel, of limestone.	D			
					1				M		
					2						
					3		SP: SAND: medium to coarse grained, brown to grey-brown; trace fines; trace organics.				
					4		SC: Organic CLAYEY SAND: fine to coarse grained, black; clay, medium plasticity, with roots and root fibres. Behaves cohesively.		VS		
					5		SP: SAND: fine to medium grained, pale grey to pale brown; trace fines.		W		
					6	End of borehole at 6.00 m					
					7						
					8						
					9						
					10						

Termination Reason: Target Depth
 Remarks:

BOREHOLE LOG - BH04

Client: Serling Consulting
 Project: 455 North Beach Road
 Location: Gwelup, WA
 Project ID: 2015-0332
 Date: 09/02/2015



Sheet 1 of 1

Logged By: ACE
 Checked By:

Position: E.385810m N.6474303m
 Elevation:

Hole Diameter: 50mm
 Angle from Horizontal: 90°

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristic; Colour, Secondary and Minor Components	Moisture Condition	Consistency	Relative Density	Structure & other observations
		Depth	Type & Results								
					0		FILL - Gravelly SAND: fine to medium grained, grey-brown; gravel, fine grained, of limestone; trace cemented fines.	D			
					1		SP: SAND: medium to coarse grained, pale brown-grey; trace fines; trace organic fines.	M			
					2						
					3		OH: Organic CLAY: medium to high plasticity, black; with roots and root fibres; trace sand.	VS			H2S odour
					4		SP: SAND: fine to medium grained, pale grey-brown; with fines (10%).	W			
					4.50	End of borehole at 4.50 m					
					5						
					6						
					7						
					8						
					9						
					10						

Termination Reason: Target Depth
 Remarks:

BOREHOLE LOG - BH05

Client: Serling Consulting
 Project: 455 North Beach Road
 Location: Gwelup, WA
 Project ID: 2015-0332
 Date: 09/02/2015



Sheet 1 of 1

Logged By: ACE
 Checked By:

Position: E.385796m N.6474333m
 Elevation:

Hole Diameter: 50mm
 Angle from Horizontal: 90°

Well	Groundwater	Samples & Insitu Tests		RL (m)	Depth (m)	Graphic Log	Material Description Soil Type, Plasticity or Particle Characteristic; Colour, Secondary and Minor Components	Moisture Condition	Consistency	Relative Density	Structure & other observations
		Depth	Type & Results								
					0		FILL - SAND: fine to medium grained, grey-brown; trace cement fines; trace fine grained gravel, of limestone.				
					1		...from 1.00m, no cobbles/gravel; trace organic fines.				
					2		OH: Organic CLAY: low to medium plasticity, black; with roots and root fibres; trace sand.				Strong H2S odour
					3		SC: Organic CLAYEY SAND: fine to medium grained, dark brown; clay (15-20%), low plasticity; with roots and root fibres; trace fine grained gravel.				
					4		SP: SAND: fine to medium grained, dark brown to brown; with fines (15-20%); with roots and root fibres (upper 150mm); trace organic fines.				
					5		SP: SAND: fine to medium grained, pale grey-brown; trace fines; trace organic fines.				
					6		End of borehole at 6.00 m				
					7						
					8						
					9						
					10						

Termination Reason: Target Depth
 Remarks:

Appendix B

Laboratory Test Results

Particle Size Distribution and Plasticity Index tests

**Mining &
Civil**

Geotest Pty Ltd

unit1/1 Pusey Road, Jandakot, WA 6164

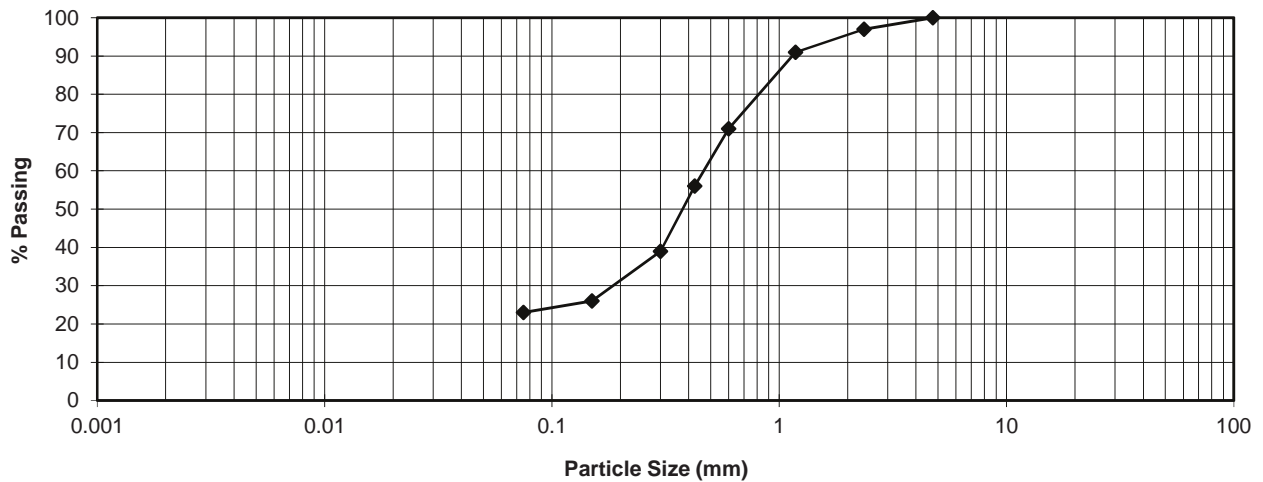
Ph (08) 9414 8022 Fax (08) 9414 8011

Email: matt@mcgeotest.com.au

Job No: 60138
Report No: 60138-P15/738
Sample No: P15/738
Issue Date: 20 February 2015

Client: CMW Geosciences
Project: Serl Consulting 455 North Beach Road
Location: Gwelup

Sample ID: BH 01
Sample Depth: 2.5 - 3.0



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	97
1.18	91
0.600	71
0.425	56
0.300	39
0.150	26
0.075	23

**Plasticity index tests
AS 1289**

Liquid limit 3.1.1	SIC	%
Plastic limit 3.2.1	NP	%
Plasticity index 3.3.1	NP	%
Linear shrinkage 3.4.1	1.5*	%

Cracked
Curled

SIC = Slipped in cup

NP = Non plastic

***Non standard test as liquid limit was not determined.**

Client Address: 127 Herdsman Parade, Wembley WA 6014

Sampling Procedure: Tested as received



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Approved signature

Matthew van Herk

AS PSDPI May 2009

Particle Size Distribution and Plasticity Index tests

**Mining &
Civil**

Geotest Pty Ltd

unit1/1 Pusey Road, Jandakot, WA 6164

Ph (08) 9414 8022 Fax (08) 9414 8011

Email: matt@mcgeotest.com.au

Job No: 60138

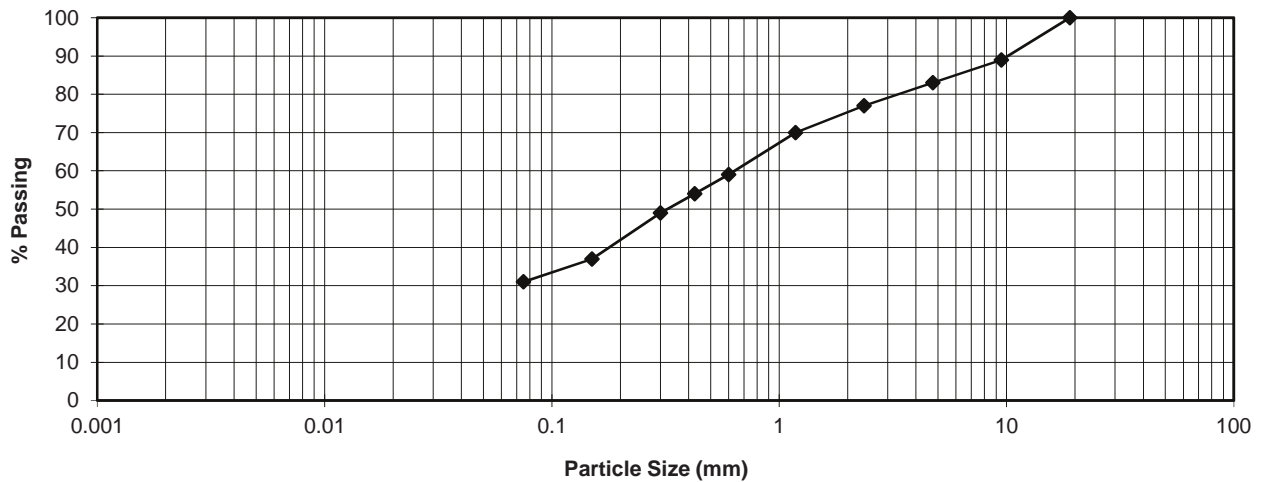
Report No: 60138-P15/739

Sample No: P15/739

Issue Date: 20 February 2015

Client: CMW Geosciences
Project: Serl Consulting 455 North Beach Road
Location: Gwelup

Sample ID: BH 01
Sample Depth: 3.0 - 4.0



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	100
37.5	100
19.0	100
9.5	89
4.75	83
2.36	77
1.18	70
0.600	59
0.425	54
0.300	49
0.150	37
0.075	31

**Plasticity index tests
AS 1289**

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked
Curled

Client Address: 127 Herdsman Parade, Wembley WA 6014

Sampling Procedure: Tested as received



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Matthew van Herk

AS PSDPI May 2009

Particle Size Distribution and Plasticity Index tests

**Mining &
Civil**

Geotest Pty Ltd

unit1/1 Pusey Road, Jandakot, WA 6164

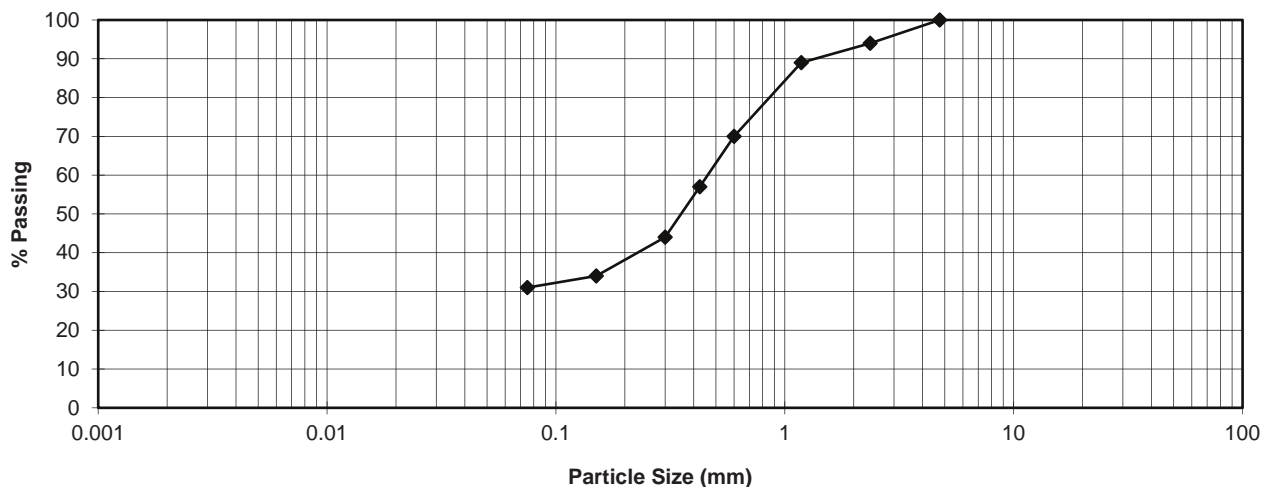
Ph (08) 9414 8022 Fax (08) 9414 8011

Email: matt@mcgeotest.com.au

Job No: 60138
Report No: 60138-P15/740
Sample No: P15/740
Issue Date: 20 February 2015

Client: CMW Geosciences
Project: Serl Consulting 455 North Beach Road
Location: Gwelup

Sample ID: BH 02A
Sample Depth: 1.5 - 1.7



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	94
1.18	89
0.600	70
0.425	57
0.300	44
0.150	34
0.075	31

Plasticity index tests

AS 1289

Liquid limit 3.1.1	na	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked
Curled

Client Address: 127 Herdsman Parade, Wembley WA 6014

Sampling Procedure: Tested as received

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AS PSDPI May 2009

Particle Size Distribution and Plasticity Index tests

**Mining &
Civil**

Geotest Pty Ltd

unit1/1 Pusey Road, Jandakot, WA 6164

Ph (08) 9414 8022 Fax (08) 9414 8011

Email: matt@mcgeotest.com.au

Job No: 60138

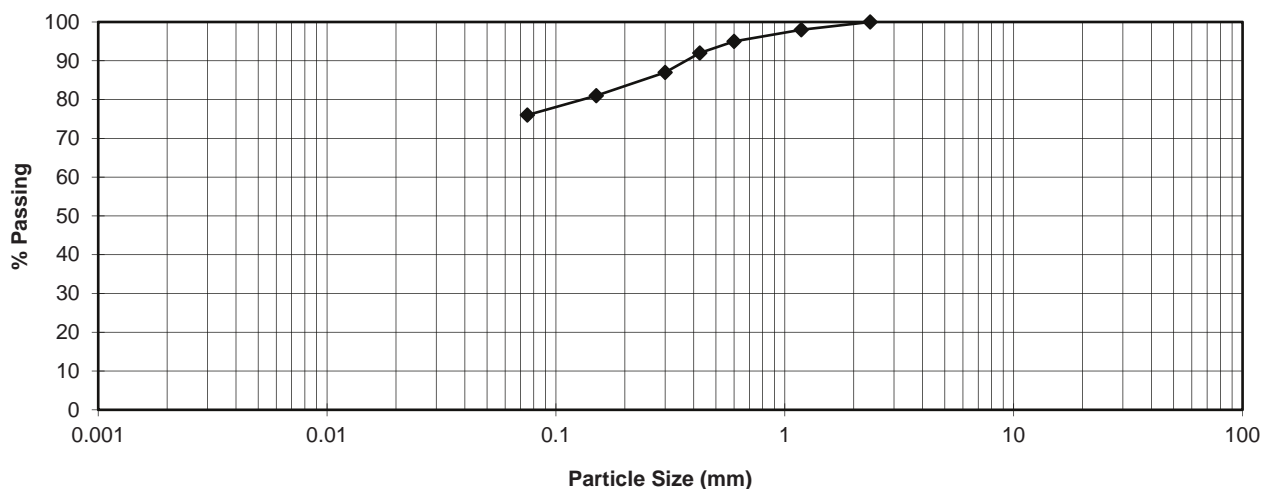
Report No: 60138-P15/741

Sample No: P15/741

Issue Date: 20 February 2015

Client: CMW Geosciences
Project: Serl Consulting 455 North Beach Road
Location: Gwelup

Sample ID: BH 02A
Sample Depth: 3.0 - 4.0



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	98
0.600	95
0.425	92
0.300	87
0.150	81
0.075	76

Plasticity index tests

AS 1289

Liquid limit 3.1.1	104	%
Plastic limit 3.2.1	69	%
Plasticity index 3.3.1	35	%
Linear shrinkage 3.4.1	9.5	%

Cracked
Curled

Client Address: 127 Herdsman Parade, Wembley WA 6014

Sampling Procedure: Tested as received

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Matthew van Herk
AS PSDPI May 2009

Particle Size Distribution and Plasticity Index tests

**Mining &
Civil**

Geotest Pty Ltd

unit1/1 Pusey Road, Jandakot, WA 6164

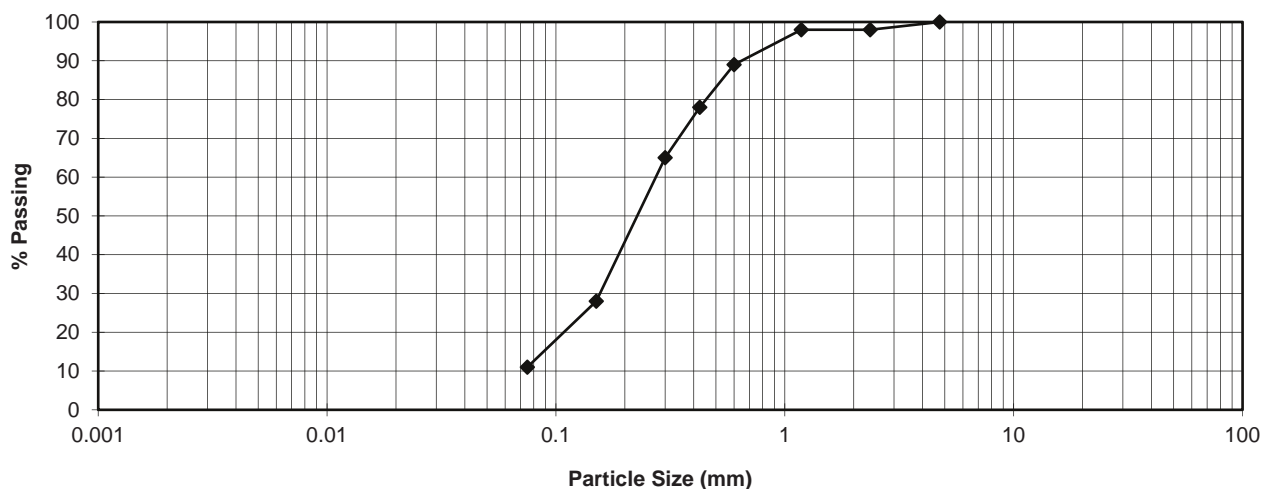
Ph (08) 9414 8022 Fax (08) 9414 8011

Email: matt@mcgeotest.com.au

Job No: 60138
Report No: 60138-P15/742
Sample No: P15/742
Issue Date: 20 February 2015

Client: CMW Geosciences
Project: Serl Consulting 455 North Beach Road
Location: Gwelup

Sample ID: BH 03
Sample Depth: 3.1 - 4.2



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	100
2.36	98
1.18	98
0.600	89
0.425	78
0.300	65
0.150	28
0.075	11

Plasticity index tests

AS 1289	SIC	%
Liquid limit 3.1.1		
Plastic limit 3.2.1	NP	%
Plasticity index 3.3.1	NP	%
Linear shrinkage 3.4.1	0.0*	%

Cracked
Curled

SIC = Slipped in cup

NP = Non plastic

***Non standard test as liquid limit was not determined.**

Client Address: 127 Herdsman Parade, Wembley WA 6014

Sampling Procedure: Tested as received

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Matthew van Herk

AS PSDPI May 2009

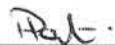
TEST CERTIFICATE
CONSISTENCY LIMITS - ATTERBERG METHOD
AS 1289 3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	Test Request No:	-
Project:	455 North Beach Road		
Project Location:	Gwelup		
Test Location:	BH02A Depth 3.0-3.5m		
Field Site #:	-	Easting: -	Northing: -
			RL: -
Material Description:	Dark grey SAND		
Sampled By:	Client	Date Sampled:	-
Tested By:	H.Dellaca	Date Tested:	26-Feb-15
Sampling Method:	Sample supplied by Client, and prepared in accordance with AS 1289 1.1		
Lab Prefix:	15-BBY		
Sample No:	S/1217		

LIQUID LIMIT	Not Obtained	%
AS 1289 3.1.1		
PLASTIC LIMIT	Non Plastic	%
AS 1289 3.2.1		
PLASTICITY INDEX	Not Obtainable	%
AS 1289 3.3.1		
LINEAR SHRINKAGE	0.0	%
AS 1289 3.4.1		

Method of preparation: Oven Dried
 Dry Sieved

Notes:


Approved Signatory: P.Kent
Date: 04-Mar-15

Accredited for compliance with ISO/IEC 17025.
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TEST CERTIFICATE
Materials finer than 75µm in aggregates (by washing)
in accordance with AS 1141.12

Client:	CMW Geosciences	Test Request No:	-
Project:	455 North Beach Road		
Project Location:	Gwelup		
Location Sampled:	BH02A Depth 3.0-3.5m		
Material Description:	Dark grey SAND		
Sampled By:	Client	Date Sampled:	-
Tested By:	P.Kent	Date Tested:	25-Feb-15
Sampling Method:	Sampled by client		

Lab Prefix:	15-BBY
Sample No:	S/1217

Percentage Passing the 75µm Sieve (%)	2
--	----------

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Accredited for compliance with ISO/IEC 17025

Approved Signatory: 
Date: 04-Mar-15



TEST CERTIFICATE
CONSISTENCY LIMITS - ATTERBERG METHOD
AS 1289 3.1.1, 3.2.1, 3.3.1 & 3.4.1

Client:	CMW Geosciences	Test Request No:	-
Project:	455 North Beach Road		
Project Location:	Gwelup		
Test Location:	BH02B Depth 3.0-3.5m		
Field Site #:	-	Easting: -	Northing: -
Material Description:	Dark grey SAND		RL: -
Sampled By:	Client	Date Sampled:	-
Tested By:	H.Dellaca	Date Tested:	26-Feb-15
Sampling Method:	Sample supplied by Client, and prepared in accordance with AS 1289 1.1		
Lab Prefix:	15-BBY		
Sample No:	S/1218		

LIQUID LIMIT AS 1289 3.1.1	Not Obtained	%
PLASTIC LIMIT AS 1289 3.2.1	Non Plastic	%
PLASTICITY INDEX AS 1289 3.3.1	Not Obtainable	%
LINEAR SHRINKAGE AS 1289 3.4.1	0.0	%

Method of preparation: Oven Dried
 Dry Sieved

Notes:

Approved Signatory: P.Kent
Date: 04-Mar-15

Accredited for compliance with ISO/IEC 17025.
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TEST CERTIFICATE**Materials finer than 75µm in aggregates (by washing)
in accordance with AS 1141.12**

Client:	CMW Geosciences	Test Request No:	-
Project:	455 North Beach Road		
Project Location:	Gwelup		
Location Sampled:	BH02B Depth 3.0-3.5m		
Material Description:	Dark grey SAND with organic material		
Sampled By:	Client	Date Sampled:	-
Tested By:	P.Kent	Date Tested:	25-Feb-15
Sampling Method:	Sampled by client		

Lab Prefix:	15-BBY
Sample No:	S/1218

Percentage Passing the 75µm Sieve (%)	6
--	----------

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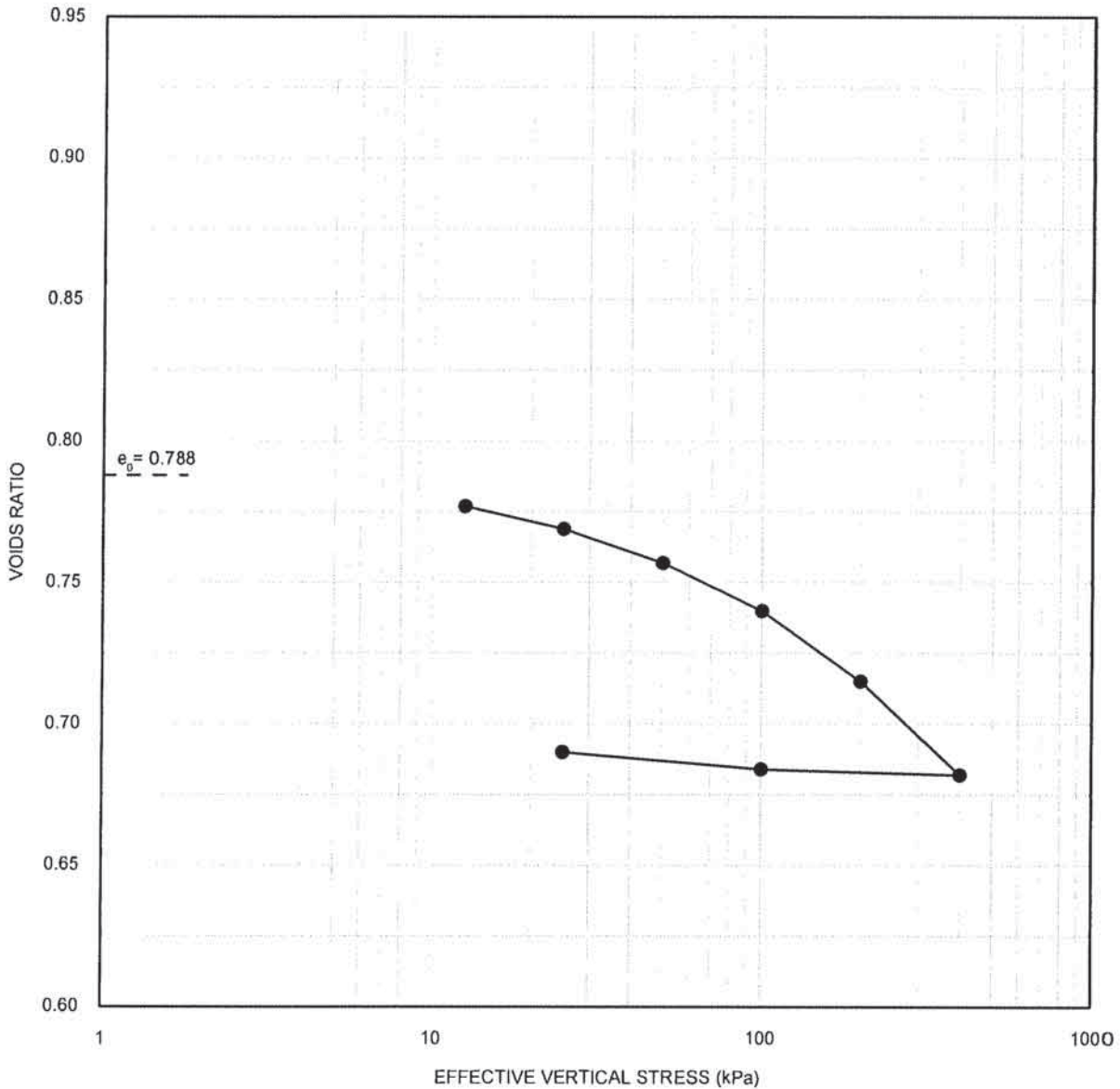
Approved Signatory:	 P.Kent
Date:	04-Mar-15

Drawn by: P.Kent
Date: 25/02/2015

Drawn by: P.Kent

Date: 17/02/15

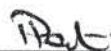
Tested by: P.Kent



Initial Conditions			Units			Coefficients for Each Load Increment		
Specimen Height	mm	20.2	Pressure (kN/m ²)	m _v (m ² /MN)	c _v (m ² /year)			
Specimen Diameter	mm	49.8	12.5	0.494	1.10			
Moisture Content	%	22	25	0.374	0.35			
Bulk Density	Mg/m ³	1.80	50	0.257	1.52			
Dry Density	Mg/m ³	1.48	100	0.194	0.68			
Particle Density	Mg/m ³	2.64 (Measured)	200	0.146	2.15			
Degree of Saturation	%	74	400	0.096	0.63			
Specimen Condition	-	Undisturbed						
Condition of Test	-	Inundated						
Swelling Pressure	kPa	NA						
Description	Brownish grey silty SAND							
Sample Details								
Borehole	:	BH02B						
Sample	:	-						
Depth (m)	:	3.2						
Cardno Geotech Sample ID	:	S/711						

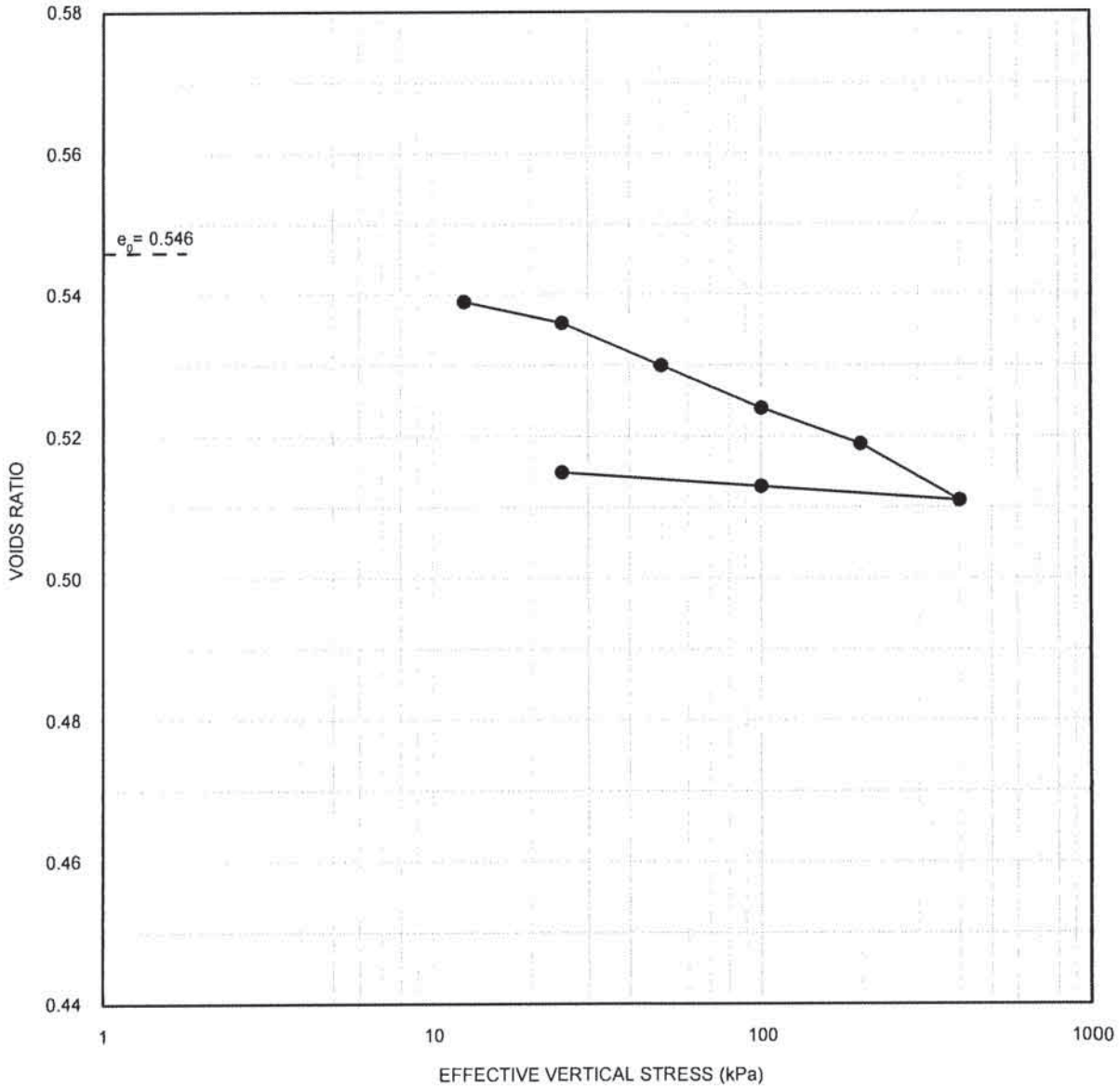
Tested in accordance with AS1289.6.6.1 - 1998

**ONE - DIMENSIONAL
CONSOLIDATION TEST (OEDOMETER)**

Approved Signatory: 
P.Kent

Date: 25/02/2015

Page 1 of 1



Initial Conditions			Coefficients for Each Load Increment		
Units			Pressure (kN/m ²)	m _v (m ² /MN)	c _v (m ² /year)
Specimen Height	mm	20.2	12.5	0.332	1.50
Specimen Diameter	mm	49.9	25	0.204	0.23
Moisture Content	%	19	50	0.132	1.30
Bulk Density	Mg/m ³	2.05	100	0.084	0.35
Dry Density	Mg/m ³	1.72	200	0.033	3.48
Particle Density	Mg/m ³	2.66 (Measured)	400	0.028	0.56
Degree of Saturation	%	93			
Specimen Condition	-	Undisturbed			
Condition of Test	-	Inundated			
Swelling Pressure	kPa	NA			
Description	Dark greyish brown SAND				
Sample Details					
Borehole	:	BH02A			
Sample	:	-			
Depth (m)	:	3.2			
Cardno Geotech Sample ID	:	S/710			

Tested in accordance with AS1289.6.6.1 - 1998

**ONE - DIMENSIONAL
CONSOLIDATION TEST (OEDOMETER)**

APPENDIX D

Careniup Swamp Special Control Area extract (City of Stirling, 2010)

6.2 Careniup Swamp Special Control Area

Note: In addition to the following provisions, the provisions of Clause 6A and Schedule 10 also apply to the Careniup Swamp Special Control Area

6.2.1 Objectives

- a) To ensure orderly subdivision of the Special Control Area;
- b) To ensure the ceding of Public Open Space;
- c) To ensure water quality standards;
- d) To ensure wildlife protection;
- e) To control filling; and
- f) To manage stormwater.

6.2.2 Special Control Area

The Careniup Swamp Special Control Area ("the Area") is all that land delineated on the Scheme Maps. In broad terms it is bounded by Balcatta Road, Mitchell Freeway, Erindale Road and North Beach Road.

6.2.3 Implementation of Development Proposals

- a) All subdivision and development within the Area shall have regard to the requirements set out in clause 6.2 and the Rehabilitation Plan provided however that any development proposal not in conformity with clause 6.2 may be carried out with the approval of Council. Council may seek input from the Western Australian Planning Commission, Water Corporation and the Department of Environment and Conservation.
- b) When considering any application for approval to commence development, subdivision, strata subdivision or the amendment of the Scheme within the Area, the Council and the applicant shall have due regard to the provisions contained within clause 6.2.
- c) When considering any application for subdivision or strata subdivision approval within the Area, the Council shall inform the Western Australian Planning Commission of the Rehabilitation Plan and the Rehabilitation Strategy, particularly when determining any public open space contribution required as a condition of a subdivision or a strata subdivision approval.

6.2.4 Ceding of Land & Cash Payments in Lieu

- a) Upon any amendment of the Scheme in respect of land within the Area, or the granting of approval to subdivide any land within the Area, whichever shall first occur, the following provisions shall take effect:
 - i) Where any portion of land is within the Core Area delineated on the Rehabilitation Plan, such portion shall be ceded to the State for vesting in the City by the owner free of costs and without any entitlement on the part of the owner or any other person with any interest therein to be paid compensation pursuant to the Public Works Act otherwise;
 - ii) If no portion of the land is within the Core Area delineated by the Rehabilitation Plan, the owner of such land shall pay to the City a sum equal to ten per centum (10%) of the market value of the land calculated as at the date of the gazettal of the amendment, the granting of approval to subdivide such land, or the granting of approval to commence development on such land as the case may be.

6.2.5 Water Quality Standards

a) Objectives

The Careniup Swamp and adjacent area is utilised by the Water Corporation as a compensating basin and it is important to maintain sufficient capacity of not less than 26,000 cubic metres within the Core Area as a modified wetland to satisfy drainage and compensation requirements. It is also vital for wildlife retention to retain permanent water throughout the Area of modified wetland, with minimum summer depths being sufficient to maintain landscape and water quality.

b) Development and Subdivision Criteria

In order to satisfy the objectives set out in the preceding sub-clause hereof, development shall conform with the following criteria and Council will recommend to the Commission in responding to a subdivision application that:

- i) The lake be designed on the basis that the area has a maximum water level of RL 7.0 metres AHD and a minimum water level of RL 6.3 metres AHD; and
- ii) The moat and lake beds referred to in the Rehabilitation Plan shall be constructed to RL 4.1 metres AHD in order to maintain a minimum water depth of 1.0 metre during the summer period.

6.2.6 Wildlife Protection Requirements

a) Objectives

Although the number and diversity of wildlife habitats has declined in past years in the Area due to filling of the Careniup Swamp at the margin, it is considered essential to reverse this trend and maximise the length of vegetated wetland foreshore, establish a system of islands within the modified wetland of the Core Area, maximise shading of water surfaces and conversely limit the extent of unshaded open water, control access to the wildlife/bird habitat areas and maximise habitat availability for water and roosting birds (with particular preference to perching and wading birds rather than swimming birds).

b) In order to satisfy the objectives set out in the preceding sub-clause hereof, the following criteria or requirements shall apply:

- i) Satisfactory provision must be made when it is practical and feasible to do so, for planting of foreshore areas by Council with native vegetation species listed in the Dames & Moore Report "Conceptual Development Plan for the Area within the System 6 Boundary - Careniup Swamp" (November 1987), with particular emphasis on the Paperbark (*Melaleuca Raphiophylla*) and Flooded Gum (*Eucalyptus Rudis*); and
- ii) Four islands specified in the Rehabilitation Plan shall, when it is practical and feasible to do so, be constructed by Council and planted with native vegetation species as determined in the Design and Management Plan.

- iii) The timing of the aforementioned works shall be specified in the Design and Management Plan.

Note: The Design and Management Plan is to be prepared and adopted by Council to outline the location of the islands, plantings, and other relevant works in accordance with clause 6.2.8 (b).

6.2.7 Maintenance of The Core Area

a) Objectives

In order to satisfy the objectives set out in the two preceding clauses hereof, the Core Area delineated in the Rehabilitation Plan must not be the subject of indiscriminate filling and infiltration of nutrients and the integrity of the Core Area as a whole must be maintained.

- b) In order to satisfy the objectives set out in the preceding sub-clause hereof, the following criteria or requirements shall apply in respect of development within the Area:
 - i) No person shall fill or deposit or cause to be filled or deposited any substance in the Core Area delineated in the Rehabilitation Plan except in accordance with a development plan approved by the Council and the Western Australian Planning Commission in consultation with the Water Corporation and the Environmental Protection Authority;
 - ii) Council shall recommend to the Western Australian Planning Commission that stormwater from subdivisions should be disposed of on site to the extent that a one in ten year storm event is retained for three to four days;
 - iii) Subdivision design should be in accordance with the principles and practices detailed in the "Planning and Management Guidelines for Water Sensitive Urban (Residential) Design", published by the Western Australian Planning Commission in June 1994.

6.2.8 Rehabilitation Programme

a) Objectives

The Core Area delineated in the Rehabilitation Plan is proposed to ultimately be vested in the Council, which intends to rehabilitate it in an orderly and comprehensive manner in accordance with the Rehabilitation Plan. A Design and Management Plan for the entire Core Area is to be prepared by the Council addressing issues such as midge and mosquito control, moat depth profiles, peat removal for housing and stormwater drainage prior to commencement of rehabilitation works.

- b) The Design and Management Plan shall be prepared when sufficient land in the Core Area has been ceded to the Crown and vested in the Council to enable rehabilitation to commence in an orderly manner or at such earlier time as determined by Council.
- c) In respect of those portions of the Core Area ultimately vested in the Council, it shall be the responsibility of the Council to carry out over time the rehabilitation of the Core Area referred to in the Rehabilitation Plan.

APPENDIX E

Hyd2o Groundwater Monitoring Results

H15006
 Lot 2 North Beach Rd Gwelup LWMS
 Groundwater Monitoring



Water Level m(AHD)		7.36 GW2		8.57 GW4		11.67 GWMB1		10.661 GWMB2		11.016 GM8		11.23 GM9		12.41 GM4		14.34 GM33		15.15 SW Gauge		
	m BIOC	m AHD	m BIOC	m AHD	m BIOC	m AHD	m BIOC	m AHD	m BIOC	m AHD	m BIOC	m AHD	m BIOC	m AHD	m BIOC	m AHD	m BIOC	m AHD	m BIOC	
20/02/2014	1.83	5.53	3.76	4.81	8.00	3.67	-	-	-	-	-	-	-	-	-	-	-	-	-	5.60
24/03/2014	1.99	5.37	3.99	4.58	8.23	3.44	-	-	-	7.56	3.67	4.56	7.85	9.87	4.47	6.19	8.96	-	-	5.50
29/04/2014	1.96	5.40	4.04	4.53	8.37	3.30	-	-	-	7.74	3.49	DRY 4.62	-	9.94	4.40	-	-	-	-	5.60
27/05/2014	1.54	5.82	3.78	4.79	8.14	3.53	-	-	-	7.48	3.75	4.37	8.04	9.75	4.59	6.13	9.02	-	-	6.05
23/06/2014	1.32	6.04	3.53	5.04	7.99	3.68	-	-	-	7.27	3.96	4.26	8.15	9.54	4.80	5.94	9.21	-	-	6.10
23/07/2014	1.18	6.18	3.19	5.38	7.72	3.95	-	-	-	7.09	4.14	4.19	8.22	9.36	4.98	5.84	9.31	-	-	6.10
29/08/2014	1.37	5.99	3.19	5.38	7.46	4.21	-	-	-	6.79	4.44	DRY 4.62	-	9.21	5.13	-	-	-	-	6.05
24/09/2014	1.29	6.07	3.03	5.54	7.26	4.41	-	-	-	6.61	4.62	4.05	8.36	9.03	5.31	5.60	9.55	-	-	6.15
31/10/2014	1.41	5.95	3.12	5.45	7.18	4.49	-	-	-	6.50	4.73	4.12	8.29	9.00	5.34	5.60	9.55	-	-	5.95
1/12/2014	1.45	5.91	3.26	5.31	7.32	4.35	-	-	-	6.64	4.59	4.21	8.20	9.11	5.23	5.64	9.51	-	-	6.10
19/03/2015	1.71	5.65	3.77	4.80	8.04	3.63	7.20	3.46	6.78	4.24	3.76	4.50	7.91	9.60	4.74	6.07	9.08	-	-	5.80

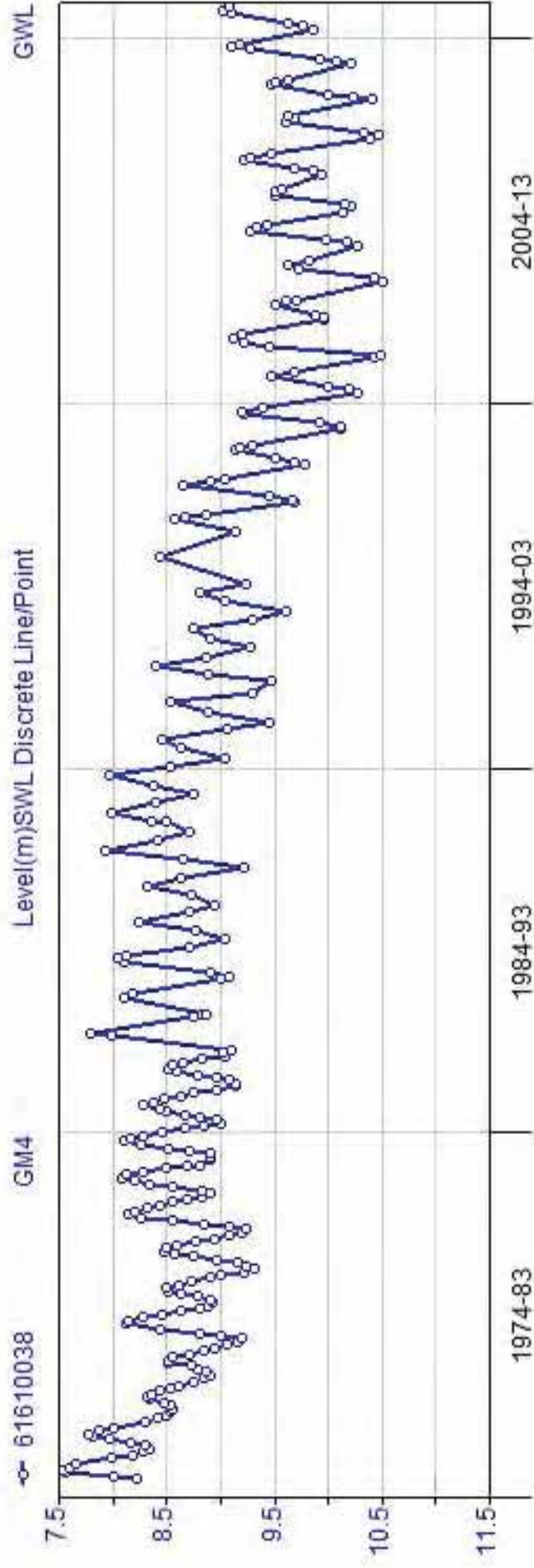
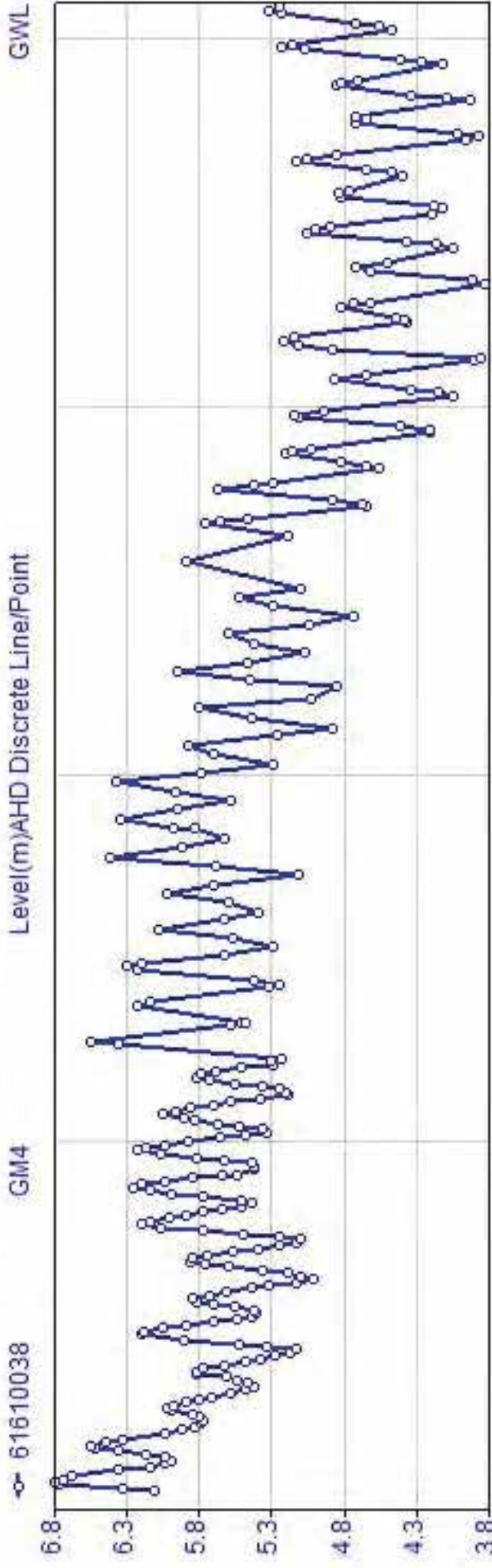
APPENDIX F

DoW Groundwater Bore Hydrographs (Department of Water, 2014)

Department of Water

Period 41 Year Plot Start 00:00_01/01/1974
Interval 1 Month Plot End 00:00_01/01/2015

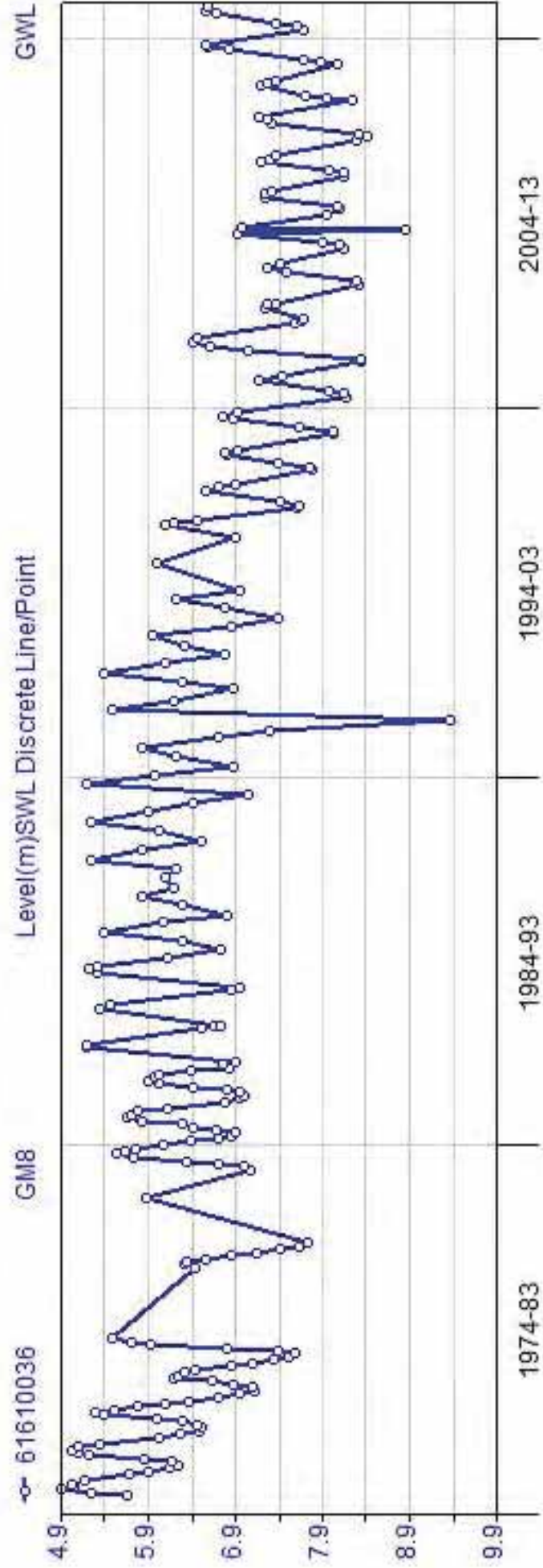
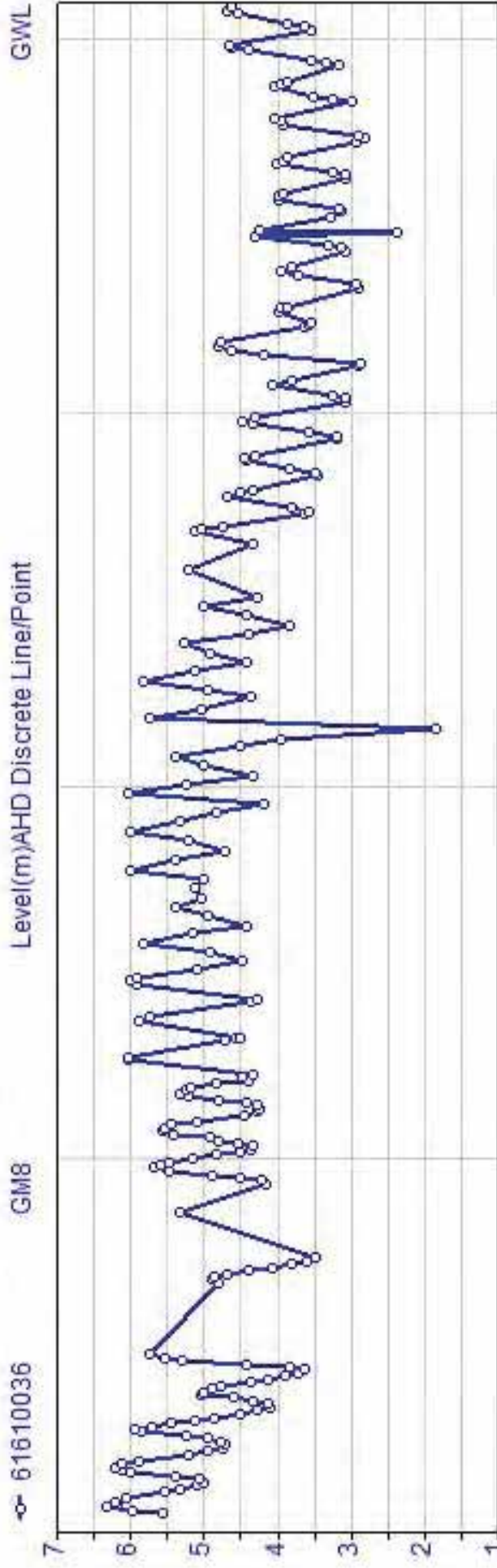
1974-15



Department of Water

Period 41 Year Plot Start 00:00_01/01/1974
Interval 1 Month Plot End 00:00_01/01/2015

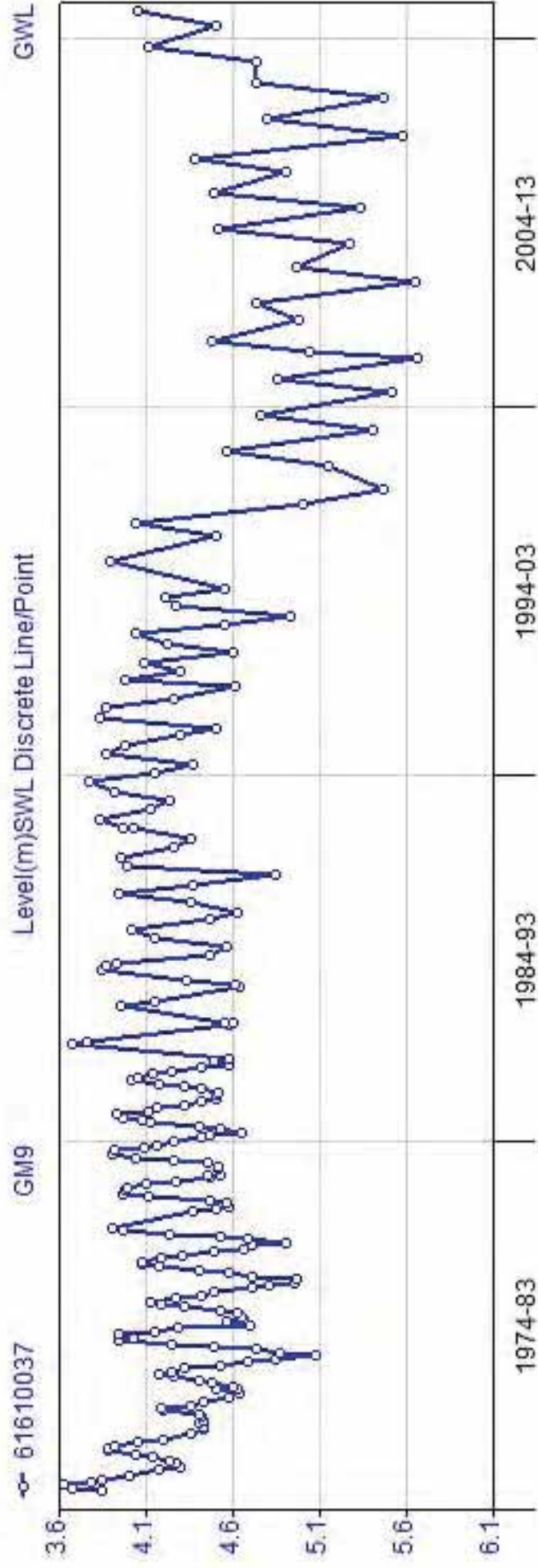
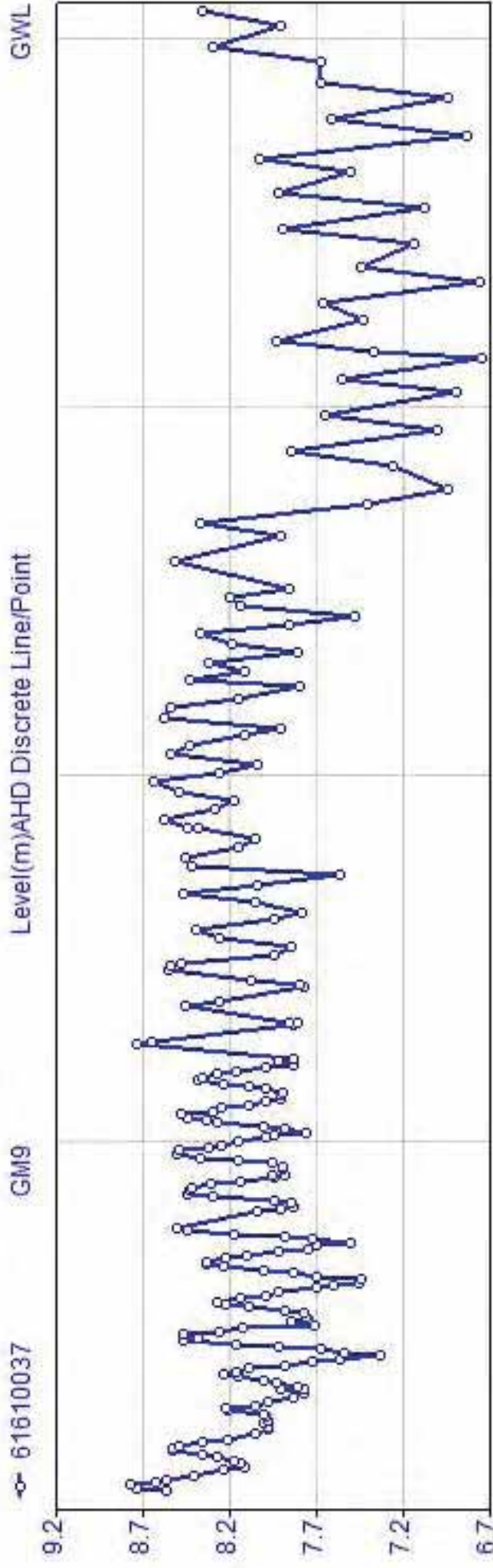
1974-15



Department of Water

Period 41 Year Plot Start 00:00_01/01/1974
Interval 1 Month Plot End 00:00_01/01/2015

1974-15

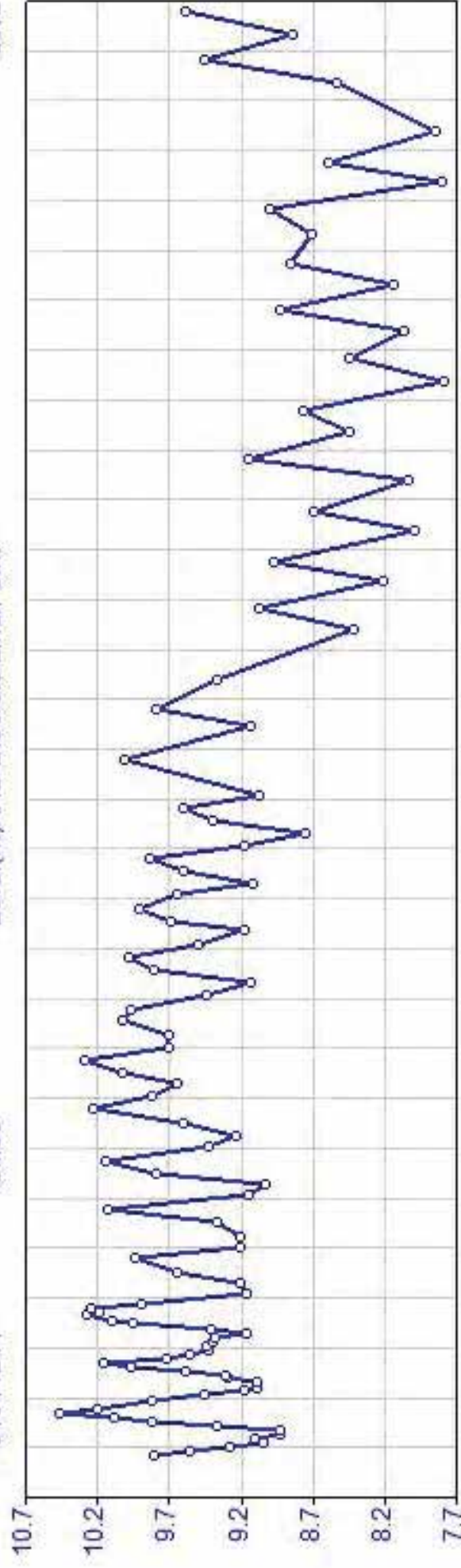


Department of Water

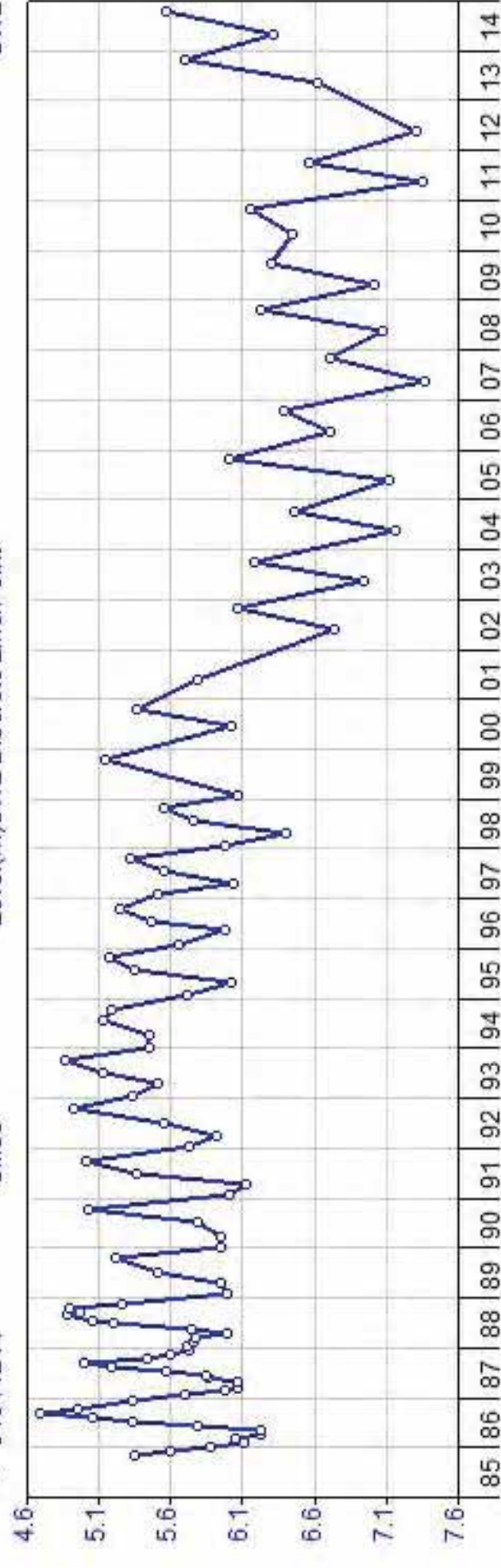
Period 30 Year Plot Start 00:00_01/01/1985
Interval 15 Day Plot End 00:00_01/01/2015

1985-15

61611211 GM33 Level(m)AHD Discrete Line/Point GWL



61611211 GM33 Level(m)SWL Discrete Line/Point GWL

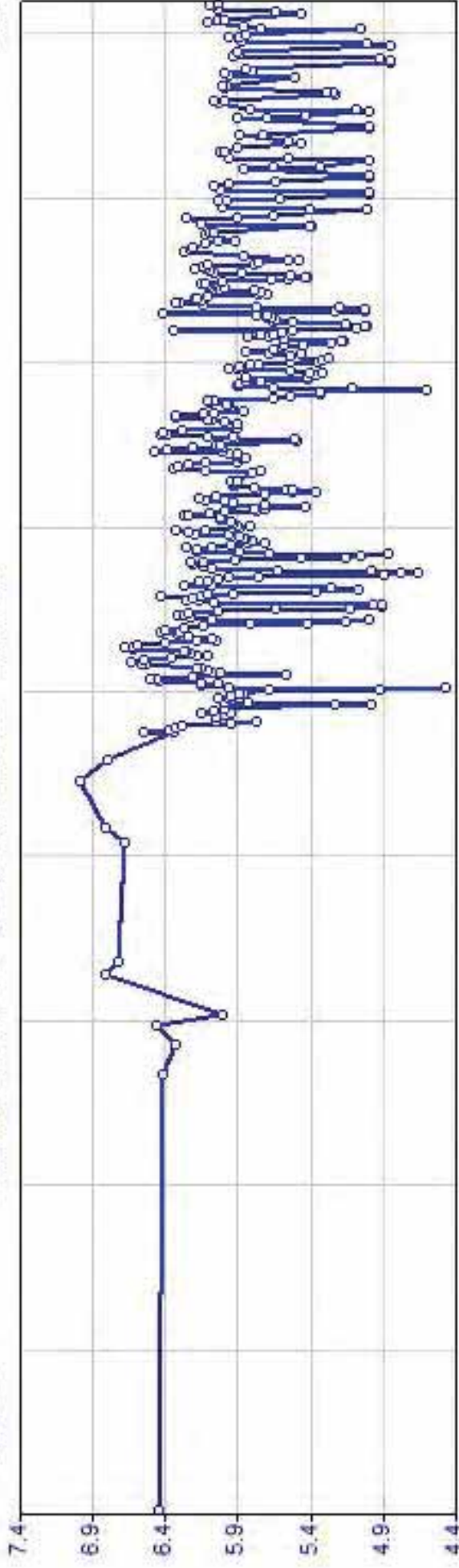


Department of Water

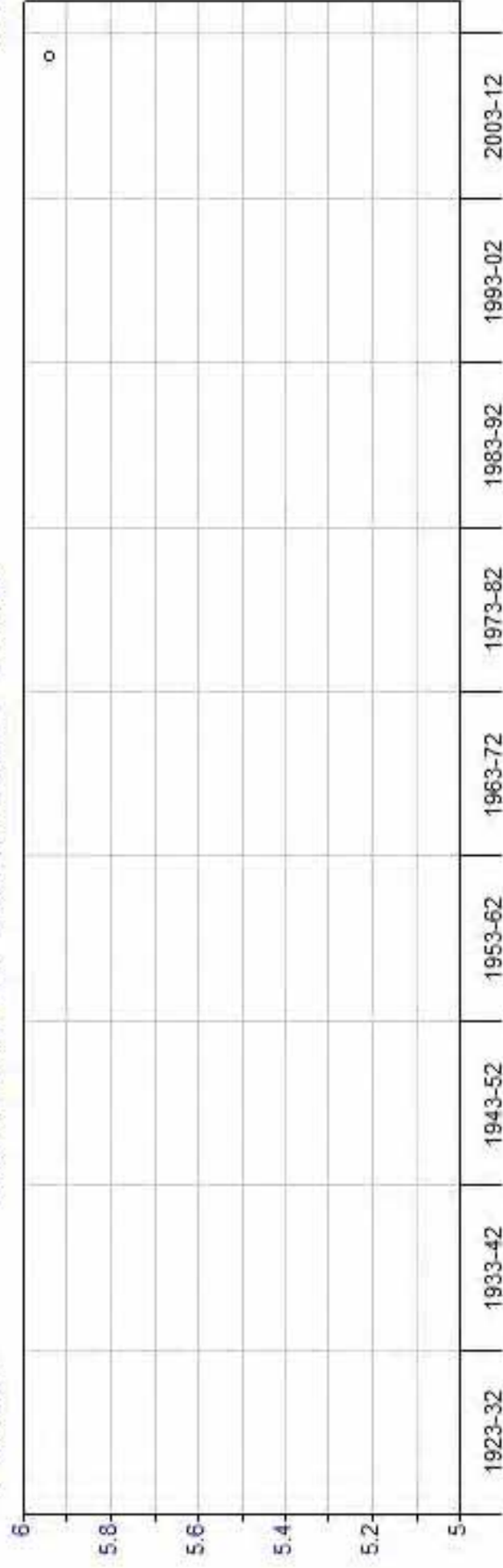
Period 92 Year Plot Start 00:00_01/01/1923
Interval 2 Month Plot End 00:00_01/01/2015

1923-15

6162508 CARENUIP SWAMP 579 Level(m)AHD Discrete Line/Point GWL



6162508 CARENUIP SWAMP 579 Level(m)SWL Discrete Line/Point GWL



APPENDIX G

Groundwater Quality Lab Report

CECILIA ELLI

Client:

100yd
 Suite 6B, 103 Rokeby Rd
 Subiaco
 WA 6008

Attention: Office

Sample log in details:

Your Reference	Lot
No. of samples	5 Water samples
Date samples received	1/03/2015
Date completed instructions received	1/03/2015
Location	

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
 Samples were analysed as received from the client. Results relate specifically to the samples as received.
 Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by	26/03/15
Date of Preliminary Report	Not issued
Issue date	26/03/15

NAA accreditation number 201. This document shall not be reproduced except in full.
 Accredited for compliance with ISO/IEC 17025.
 Tests not covered by ISO are denoted with

Results Approved by:



Joshua Lim
 Operations Manager

Client Reference 163445
 Revision No R 00

Miscellaneous Organics Our Reference Your Reference	NO	163445-1 15006 W1	163445-2 15006 W2	163445-3 15006 W4	163445-4 15006 WB1	163445-5 15006 WB1 Q
Date Sampled Type of sample	-----	1/03/2015 Ground Water	1/03/2015 Ground Water	1/03/2015 Ground Water	1/03/2015 Ground Water	1/03/2015 Ground Water
Date prepared	-	25/03/2015	25/03/2015	25/03/2015	25/03/2015	25/03/2015
Date analysed	-	25/03/2015	25/03/2015	25/03/2015	25/03/2015	25/03/2015
Total Suspended Solids	mg/L	3,400	170	20	520	730

Nutrients in Water Our Reference Your Reference	Unit	163445-1 15006 W1	163445-2 15006 W2	163445-3 15006 W4	163445-4 15006 W B1	163445-5 15006 W B1
Date Sampled		10/03/2015	10/03/2015	10/03/2015	10/03/2015	10/03/2015
Type of sample		Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Date prepared	-	25/03/2015	25/03/2015	25/03/2015	25/03/2015	25/03/2015
Date analysed	-	25/03/2015	25/03/2015	25/03/2015	25/03/2015	25/03/2015
Total Nitrogen (Total N)	mg/L	26	3.2	14	1.6	4.0
Total N by discrete Analyser	mg/L	26	3.2	3.2	1.6	4.0
Nitrate as N	mg/L	0.005	0.005	11	0.014	0.010
Nitrite as N	mg/L	0.005	0.010	0.001	0.005	0.005
Ammonia as N	mg/L	1.7	0.86	0.010	0.16	1.7
Total Phosphorus (Total P)	mg/L	6.5	0.21	0.05	0.11	0.13
Phosphate as P	mg/L	0.014	0.005	0.006	0.005	0.005

Details in Water - Low Level	Client Reference	163445-1 15006 W1	163445-2 15006 W2	163445-3 15006 W4	163445-4 15006 WB1	163445-5 15006 WB1
Date Sampled		10/03/2015	10/03/2015	10/03/2015	10/03/2015	10/03/2015
Type of sample		Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Date prepared	-	24/03/2015	24/03/2015	24/03/2015	24/03/2015	24/03/2015
Date analysed	-	24/03/2015	24/03/2015	24/03/2015	24/03/2015	24/03/2015
Arsenic-Dissolved	mg/L	0.043	0.024	0.002	0.003	0.005
Cadmium-Dissolved	mg/L	0.0001	0.0001	0.0001	0.0001	0.0001
Chromium-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.003
Copper-Dissolved	mg/L	0.001	0.001	0.003	0.007	0.001
Lead-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001
Mercury-Dissolved	mg/L	0.00005	0.00005	0.00005	0.00006	0.00005
Nickel-Dissolved	mg/L	0.001	0.001	0.001	0.001	0.001
Zinc-Dissolved	mg/L	0.006	0.004	0.002	0.015	0.005

Method	Methodology Summary
ISO 10300	Suspended Solids - determined gravimetrically by filtration of the sample. The samples are dried at 104±5°C.
ISO 10300	Total Nitrogen by colourimetric analysis based on APHA 4500-N ₃ .
ISO 10300	TN by calculation from Total Nitrogen and N ₂ using APHA methodology.
ISO 10300	Nitrate by colourimetric analysis and calculation.
ISO 10300	Nitrite by colourimetric analysis based on APHA latest edition 4500-N ₂ B.
ISO 10300	Ammonia by colourimetric analysis based on APHA latest edition 4500-N ₃ .
EPA 8210	Metals in soil and water by EPA-8210.
ISO 10300	Phosphate by colourimetric analysis based on APHA latest edition 4500-P.
Metals ICP	Determination of various metals by ICP-MS.
Metals Cold Vapor AA	Determination of Mercury by Cold Vapor AA.

ALLOY CONTROL	UNIT	COL	METHOD	Blank	Duplicate (m)	Duplicate results	Pike (m)	Pike Recovery
Miscellaneous Organics						Base II Duplicate II R		
Date prepared	-			25/03/2015	163445-1	25/03/2015 25/03/2015	L-1	25/03/2015
Date analysed	-			25/03/2015	163445-1	25/03/2015 25/03/2015	L-1	25/03/2015
Total Suspended Solids	mg/L	5	INRO-010	5	163445-1	3400 (N/)	L-1	80
Nutrients in Water						Base II Duplicate II R		
Date prepared	-			25/03/2015	IN	IN	L-1	25/03/2015
Date analysed	-			25/03/2015	IN	IN	L-1	25/03/2015
Total Nitrogen (Total N)	mg/L	0.1	INRO-055	0.1	IN	IN	L-1	115
TN by Discrete Analyser	mg/L	0.1	INRO-062	0.1	IN	IN	NR	NR
Nitrate as N	mg/L	0.005	INRO-055	0.005	IN	IN	L-1	40
Nitrite as N	mg/L	0.005	INRO-055	0.005	IN	IN	L-1	100
Ammonia as N	mg/L	0.005	INRO-057	0.005	IN	IN	L-1	60
Total Phosphorus (Total P)	mg/L	0.05	ALD-020	0.05	IN	IN	L-1	102
Phosphate as P	mg/L	0.005	INRO-060	0.005	IN	IN	L-1	100
Metals in Water - Low Level						Base II Duplicate II R		
Date prepared	-			24/03/2015	163445-2	24/03/2015 24/03/2015	L-1	24/03/2015
Date analysed	-			24/03/2015	163445-2	24/03/2015 24/03/2015	L-1	24/03/2015
Arsenic-Dissolved	mg/L	0.001	Metals-022	0.001	163445-2	0.024 (N/)	L-1	80
Cadmium-Dissolved	mg/L	0.0001	Metals-022	0.0001	163445-2	0.0001 (N/)	L-1	110
Chromium-Dissolved	mg/L	0.001	Metals-022	0.001	163445-2	0.001 (N/)	L-1	101
Copper-Dissolved	mg/L	0.001	Metals-022	0.001	163445-2	0.001 (N/)	L-1	100
Lead-Dissolved	mg/L	0.001	Metals-022	0.001	163445-2	0.001 (N/)	L-1	108
Mercury-Dissolved	mg/L	0.00005	Metals-021	0.00005	163445-2	0.00005 0.00005	L-1	101
Nickel-Dissolved	mg/L	0.001	Metals-022	0.001	163445-2	0.001 (N/)	L-1	101
Zinc-Dissolved	mg/L	0.001	Metals-022	0.001	163445-2	0.004 (N/)	L-1	102

ANALYTICAL CONTROL	UNIT	Sample	Duplicate	Sample	Sample Recovery
Nutrients in Water					
Date prepared	-	163445-2	163445-2	163445-2	25/03/2015
Date analysed	-	163445-2	163445-2	163445-2	25/03/2015
Total Nitrogen (Total N)	mg/L	163445-2	163445-2	163445-2	108%
TN by Discrete Analyser	mg/L	163445-2	163445-2	163445-2	NR
Nitrate as N	mg/L	163445-2	163445-2	163445-2	NR
Nitrite as N	mg/L	163445-2	163445-2	163445-2	NR
Ammonia as N	mg/L	163445-2	163445-2	163445-2	NR
Total Phosphorus (Total P)	mg/L	163445-2	163445-2	163445-2	NR
Phosphate as P	mg/L	163445-2	163445-2	163445-2	NR
ANALYTICAL CONTROL					
Metals in Water - Low Level					
Date prepared	-	163445-5	24/03/2015 24/03/2015	163445-3	24/03/2015
Date analysed	-	163445-5	24/03/2015 24/03/2015	163445-3	24/03/2015
Arsenic-Dissolved	mg/L	163445-5	0.005 0.005 NR	163445-3	NR
Cadmium-Dissolved	mg/L	163445-5	0.0001 0.0001	163445-3	NR
Chromium-Dissolved	mg/L	163445-5	0.003 0.003 NR	163445-3	NR
Copper-Dissolved	mg/L	163445-5	0.001 0.001 NR	163445-3	NR
Lead-Dissolved	mg/L	163445-5	0.001 0.001	163445-3	NR
Mercury-Dissolved	mg/L	163445-5	0.00005 IN	163445-3	0%
Nickel-Dissolved	mg/L	163445-5	0.001 0.001	163445-3	NR
Zinc-Dissolved	mg/L	163445-5	0.005 0.005 NR	163445-3	NR
ANALYTICAL CONTROL					
Miscellaneous Organics					
Date prepared	-	163445-2	25/03/2015 25/03/2015	163445-2	25/03/2015
Date analysed	-	163445-2	25/03/2015 25/03/2015	163445-2	25/03/2015
Total Suspended Solids	mg/L	163445-2	170 170 NR	163445-2	NR

Report Comments:

Relative Percent Difference (NA) test not required
 Laboratory Control Sample
 Insufficient sample for this test
 Not tested
 Practical Quantitation Limit
 Less than
 Greater than
 Not specified
 National Environmental Protection Measure

Quality Control Definitions

Blank - This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate - This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike - A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LC (Laboratory Control Sample) - This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LC in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however were analysed at a frequency to meet or exceed NEMO requirements. All samples are tested in batches of 20. The duplicate sample and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction. Spikes for physical and Aggregate tests are not applicable

For metals in water samples, three values are required for duplicate or spike analysis

Duplicates 500L - any R% is acceptable
 500L - 0-500 R% is acceptable.

Matrix spike and LC generally 70-130% for inorganics/metals
 60-140% for organics

10-140% for PCBs and Speciated Phenols
 and 40-120% for low level organics is acceptable.

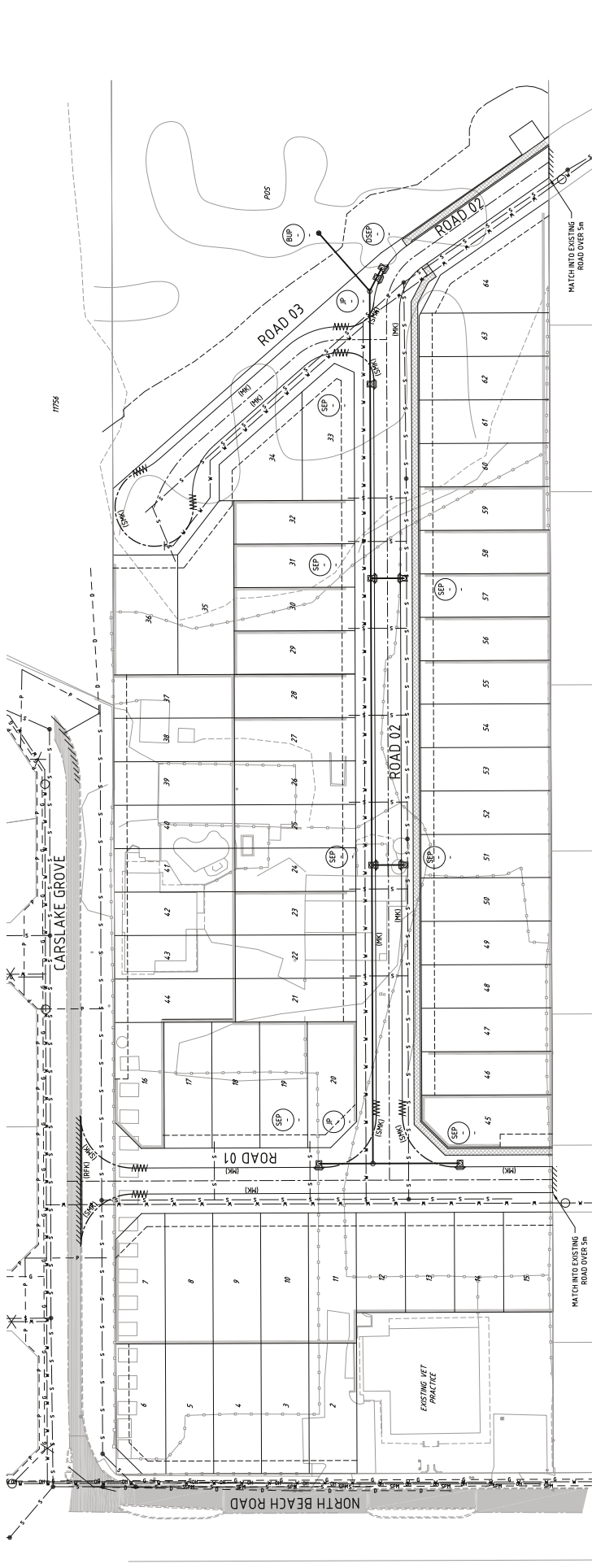
Surrogates 60-140% is acceptable for general organics and 10-140% for PCBs and Speciated Phenols.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (hours) the analysis has proceeded. Where analytes are on the verge of breaching hours, every effort will be made to analyse within the hours or as soon as practicable.

APPENDIX H

Bulk Earthworks Engineering Drawing (Serling Consulting)



PLAN
SCALE 1500

- LEGEND**
- PROPOSED REINFORCED FLUSH KERB
 - PROPOSED MOUNTABLE KERB
 - PROPOSED SEMI MOUNTABLE KERB
 - 2.0m KERB TRANSITION
 - EXTENT OF WORKS
 - PROPOSED RETAINING WALLS
 - STREET SIGNS TO BE SUPPLIED & INSTALLED BY CONTRACTOR AS PER COUNCIL STD DRG. ESTER.
 - SKIN OUT EXISTING PAVEMENT AND MAKE SMOOTH TRANSITION TO EXISTING PAVEMENT. SEE NOTE 2.6
 - PROPOSED 1.0m FOOTPATH
 - EXISTING DRAINAGE
 - SEWER
 - TELSTRA
 - GAS
 - UNDERGROUND POWER
 - WATER
 - SEWER PRESSURE MAIN
 - UPSTREAM INVERT LEVEL
 - PIPE DIA / CLASS IF NOT '2' / GRADE
 - LENGTH
 - DOWNSTREAM INVERT LEVEL
 - PIT TYPE
 - PIT NUMBER
 - PIT CHANGE

- NOTES**
1. GENERAL
 - 1.1. THE CONTRACTOR SHALL LIMIT THE MOVEMENT OF EQUIPMENT AND HANDPOWER TO THE MINIMUM AREA NECESSARY AND PROTECT ALL VEGETATION ON SITE.
 - 1.2. CONTRACTOR SHALL OBTAIN A COPY OF ALL RELEVANT COUNCIL STANDARD DRAWINGS FOR ALL SUBDIVISIONAL WORKS. ALL WORKS SHALL BE CARRIED OUT TO THE REQUIREMENTS OF THE LOCAL AUTHORITY.
 2. ROADWORKS
 - 2.1. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE ROAD PROFILES AND THE INTERSECTION DETAILS.
 - 2.2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUBMITTING TRAFFIC MANAGEMENT PLAN AND ROAD CLOSURE APPLICATION TO THE LOCAL COUNCIL FOR APPROVAL. AT LEAST 2 WEEKS BEFORE COMMENCEMENT OF WORKS.
 - 2.3. THE CONTRACTOR SHALL MAKE ALL ALLOWANCES NECESSARY FOR RESTATEMENT OF ANY AREAS DISTURBED BY THE WORKS TO ORIGINAL CONDITION TO THE SATISFACTION OF THE LOCAL AUTHORITY.
 - 2.4. ALL ROADS TO BE CENTRALLY LOCATED UNLESS NOTED OTHERWISE ON THE DRAWINGS. ROAD CENTRELINE WIDTH IS ELECTRONICALLY AVAILABLE BY CONTRACTING SURVEYING.
 - 2.5. ALL CORNER SWEEPS SHALL BE 12.0m RADIUS KEYED UNLESS OTHERWISE SHOWN.
 - 2.6. ALL KERBS SHALL BE MOUNTABLE UNLESS OTHERWISE SHOWN. SWEEPS SHALL BE SEMI MOUNTABLE.
 - 2.7. ALL ROAD JUNCTIONS & DISTURBED AREAS SHALL BE STABILISED BY APPLICATION OF ALLUDED TOP SOIL.
 - 2.8. ALL STREET NAME PLATES SHALL BE FIXED TO LIGHTING COLUMNS WHERE PRACTICAL.
 - 2.9. FOOTPATHS
 3. DRAINAGE
 - 3.1. DRAINAGE PIPE SHALL BE CLASS 2 R90 UNLESS OTHERWISE NOTED.
 - 3.2. ALL TRENCHING, PIPE BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH AS3725.
 - 3.3. ALL GRADED GULLY PITS WITHIN TRAFFICABLE AREAS AND CYCLEWAYS SHALL HAVE CYCLE-SAFE GRATING.
 - 3.4. ALL JUNCTION PITS, GULLIES AND SIDE ENTRY PITS SHALL BE LOCATED AS SHOWN ON THE DRAWINGS IRRESPECTIVE OF PIPE LENGTHS SHOWN ON THE DRAWINGS.
 - 3.5. CENTRELINES OF MANHOLES TO BE ALIGNED 3.0m FROM ROAD RESERVE BOUNDARY UNLESS OTHERWISE SHOWN.
 - 3.6. GROSS POLLUTANT TRAP SHALL BE SMARTSTREAM ECO-BITE OR SIMILAR APPROVED SUBSOL RISER SHALL BE 100 DIA PVC WITH SCREW CAP FITTING WITHIN G COVER BOX/ZZ24/TK254 DEPTH. SPACING SHALL BE 50m APPROX.

WARNING
BEWARE OF UNDERGROUND SERVICES.
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DARRON BAYHAM			C300		
PROJECT			PROJECT No.		
455 (LOT 21) NORTH BEACH ROAD, GWELPUP			SC00188.100		
DRAWER			SCALE		
R. BARBERIS			1:1500		
DESIGN REVIEW			SHEET		
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R. BARBERIS			11		
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R. BARBERIS					
APPROVED PROJECT MANAGER			DATE		
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ROADS AND DRAINAGE PLAN

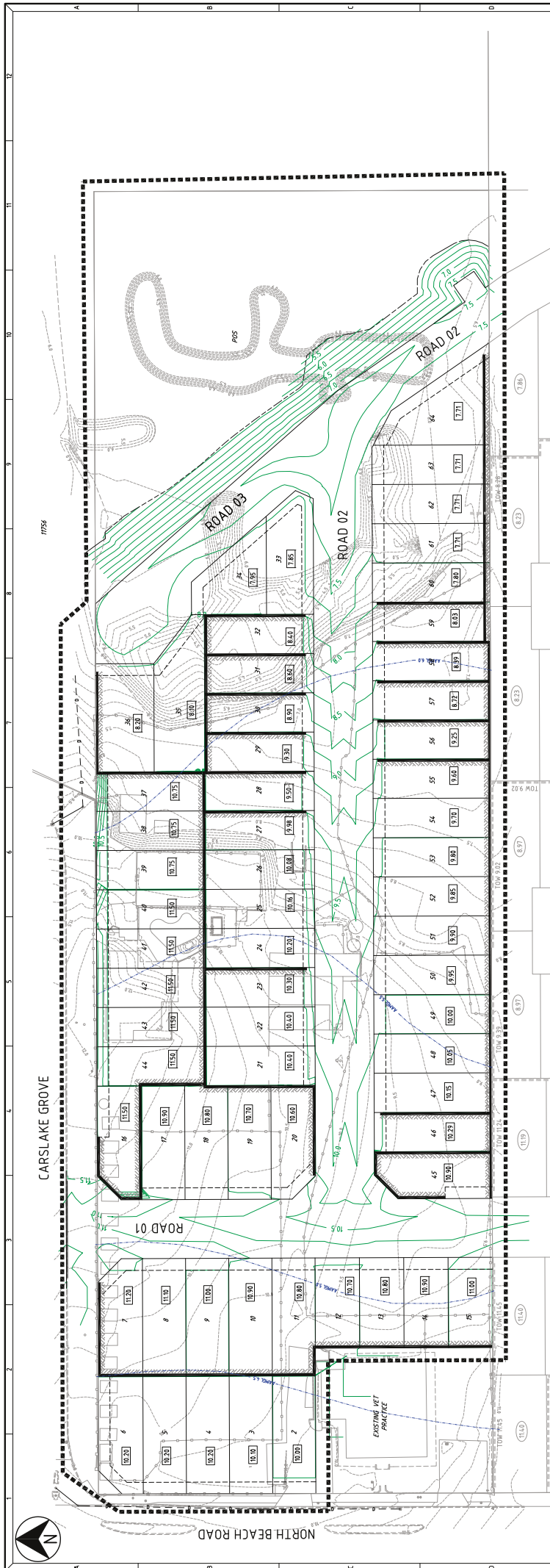
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PROJECT No. SC00188.100

SCALE 1:1500

DATE



- LEGEND**
- LIMIT OF WORKS BOUNDARY
 - EXISTING RETAINING WALLS
 - LOT SIDE BEING RETAINED
 - PROPOSED RETAINING WALLS
 - DESIGN FINISHED LOT LEVEL
 - EXISTING CONTOURS
 - EXISTING CONTOURS
 - LOT NUMBER
 - SPOT HEIGHT
 - EXISTING TREES TO BE REMOVED
 - EXISTING TREES TO BE RETAINED
- NOTES**
- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DRAWINGS AND SPECIFICATION.
 - THE CONTRACTOR SHALL REMOVE AND REPOSE ALL MISCELLANEOUS DEBRIS AND BRUSH, CONCRETE PAVEMENT, CURBS, GATES, INTERNAL FENCING, UNSUITABLE MATERIAL ETC FROM WITHIN THE LIMIT OF WORKS SITE.
 - THE PLACEMENT OF FILL SHALL NOT COMPROMISE THE GEOTECHNICAL ENGINEER HAS UNSPECIFIED THE WORKS, INCLUDING THE PROOF ROLLING.
 - THE CONTRACTOR SHALL MAKE APPROPRIATE ALLOWANCE IN THE DESIGN OF THE FOUNDATIONS FOR ALL EXISTING BUILDINGS WITHIN THE VICINITY OF THE SITE OF WORKS WHICH COULD BE AFFECTED BY THE ACTIVITIES PRIOR TO COMMENCEMENT OF WORKS ON SITE.
 - THE CONTRACTOR SHALL ALLOW FOR CLEARING, MULCHING AND REMOVAL OF MULCHED MATERIAL.
 - THE CONTRACTOR SHALL REMOVE AND STOCKPILE THE TOP SOIL ON SITE OFF SITE UNLESS OTHERWISE DIRECTED DURING CONTRACT NEGOTIATION.
 - THE CONTRACTOR SHALL SCREEN THE EXISTING STOCKPILED MATERIAL TO REMOVAL OF ALL DEBRIS AND GEOTECHNICAL ENGINEERS INSPECTION.
 - ALL FILL SHALL BE FREE DRAINING CLEAN GRANULAR MATERIAL AND SHALL BE COMPACTED EXCEEDING 300M COMPACTED THICKNESS TO 95% MHDD.
 - THE CONTRACTOR SHALL ALLOW FOR ROAD BOX-OUT WHEN DESIGN CONTOURS ON THIS DRAWING REFER TO ROAD PLAN AND PROFILE DRAWINGS FOR WIDTH AND CROSSFALL.
 - THE CONTRACTOR SHALL MAKE THEIR OWN DETERMINATION OF THE LOCATION OF ALL UTILITIES AND SERVICES WHICH CAN BE PROVIDED BY SERING CONSULTING IF REQUIRED.
 - THE CONTRACTOR SHALL PROOF ROLL ALL FILL AREA'S PRIOR TO THE PLACEMENT OF FILL.
 - BATTERS TO EXISTING LEVELS SHALL NOT EXCEED 1 IN 3 SLOPE GENERALLY AND 1 IN 6 IN TIGHT AREAS.
 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR DUST CONTROL AND ENSURE THAT WORKS COMPLY WITH THE 'DUST MANAGEMENT PLAN' - REFER SPECIFICATION.
 - THE CONTRACTOR SHALL GIVE NOTICE TO OCCUPERS OF ANY EXISTING DWELLINGS WITHIN AND AROUND THE PERIMETER OF THE SITE OF THE IMPENDING WORKS AT LEAST 1 WEEK PRIOR TO STARTING THE WORKS.
 - THE CONTRACTOR SHALL BE RESPONSIBLE FOR ARRANGING DILATION REPORTS FOR ALL EXISTING BUILDINGS WITHIN THE VICINITY OF THE SITE OF WORKS WHICH COULD BE AFFECTED BY THE ACTIVITIES PRIOR TO COMMENCEMENT OF WORKS ON SITE.
 - THE CONTRACTOR SHALL HAVE SUFFICIENT WATER CARTS ON SITE SUCH THAT ONE WATER CART IS IN OPERATION AT ALL TIMES.
 - THE CONTRACTOR SHALL MAKE NECESSARY ALLOWANCE FOR REINSTATEMENT OF ALL AREAS DISTURBED BY THE WORKS.
 - THE CONTRACTOR SHALL MAKE APPROPRIATE ALLOWANCE IN THE DESIGN OF THE FOUNDATIONS FOR ALL EXISTING BUILDINGS WITHIN THE VICINITY OF THE SITE OF WORKS WHICH COULD BE AFFECTED BY THE ACTIVITIES PRIOR TO COMMENCEMENT OF WORKS ON SITE.
 - THE CONTRACTOR SHALL ERECT TYPE A WIND FENCING ACROSS THE REAR AND SIDE BOUNDARY OF THE WET CLIMB ROAD AS NOTATED ON THE DRAWING. FENCING TO BE ERECTED PRIOR TO EARTHWORKS COMMENCING ON SITE.
 - THE CONTRACTOR IS MAKE ALLOWANCE FOR ALL SEPTIC TANKS AND SERVICES WHICH ARE NOT SHOWN OR DISREGARDED IN ACCORDANCE WITH THE HEALTH REQUIREMENTS.

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CLIENT: DARRON BAYHAM
PROJECT: 455 (LOT 2) NORTH BEACH ROAD, GWELUP
DRAWER: R. BARBERIS
DESIGN CHECK: R. BARBERIS
DESIGN REVIEW: R. BARBERIS
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APPENDIX 4

BUSHFIRE MANAGEMENT PLAN



ROWEGROUP

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup

Project No: EP15-021(02)

Prepared for Darron Banyham
March 2017

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



Document Control

Doc name:		Bushfire Management Plan 455 (Lot 2) North Beach Road, Gwelup			
Doc no.:		EP15-021(02)--009			
Version	Date	Author		Reviewer	
1	March 2017	Dylan Martini	DCM	Jen Longstaff	
				Rohan Carboon	
Revision of EP15-021(02)—003a to be consistent with the updated bushfire planning framework and following changes to the Structure Plan					

Disclaimer:

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The content of this document has been prepared primarily to consider the layout of the development or the appropriate building construction standard, where relevant. The measures outlined are considered to be prudent minimum standards only based on the relevant experience of the author and the standards prescribed by the relevant authorities. The level of implementation of the fire precautions achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. Your local government and relevant fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions adopted in this report, it should always be remembered that bushfires burn under a wide range of conditions. An element of risk, no matter how small always remains. The objective of the Australian Standard AS 3959-2009 is to "prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire while the front passes" (Standards Australia 2009). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be lost.

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Executive Summary

Darron Banyham (the proponent) proposes to develop 455 (lot 2) North Beach Road, Gwelup for residential land uses. This area is herein referred to as “the site. The site is 3.4 ha in area, and is located approximately 12 km north-west of the Perth Central Business District, within the City of Stirling as shown in **Figure 1**. The site is zoned “Urban deferred” under the Metropolitan Region Scheme (MRS) and “Development” under the City of Stirling’s Local Planning Scheme (LPS) No. 3.

The proponent is progressing with residential development in accordance with the proposed structure plan attached as **Appendix A**. Future development of the site will include subdivision of the site into multiple residential lots, public roads and areas of public open space and drainage reserves.

The site is currently identified as a “Bushfire Prone Area” under the state-wide *Map of Bush Fire Prone Areas* released by the Office of Bushfire Risk Management (OBRM 2016). This Bushfire Management Plan (BMP) has been prepared to support the proposed residential development of the site and includes an assessment of bushfire hazard levels in the vicinity of the site (within 100 metres), in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015), the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017) (the Guidelines) and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009). This BMP has also been prepared to ensure that any bushfire risk is appropriately managed through the layout of the development and the implementation of appropriate construction standards where necessary.

The bushfire hazards identified within 100 m of the site include remnant bushland vegetation to the west of the site located within the Lake Karrinyup Country Club golf course, and wetland vegetation to the east of the site associated with the Careniup Swamp.

In the post-development scenario the site will be developed for residential land uses, which will involve the clearing of the majority of vegetation within the site, with some remnant vegetation to be retained within public open space in the eastern portion of the site.

A Bushfire Attack Level (BAL) assessment has been undertaken as part of this BMP and considers the extent of post development classified vegetation and applicable effective slope within 100 m of the site. The BAL contours applicable to the site, based on the post-development scenario, have been provided in **Figure 6**. Based on fuels west of the site, BAL-40 currently extends into the western portion of the site, however can be mitigated through the utilisation of appropriate measures (internal lot Asset Protection Zones (APZ) and increased construction standards). Consequently BAL-29 will not be exceeded for any future dwellings located within the site.

The outcomes of this BMP indicate that the bushfire protection criteria outlined within the Guidelines (WAPC and DFES 2017) can be achieved as part of the proposed development. Bushfire risk will be managed through the following:

- Strategically locating, siting and designing the development to ensure buildings are not exposed to an unacceptable level of radiant flux, without appropriate mitigation measures. Separation will be provided between dwellings and post-development classified vegetation as part of subdivision of the site and will be implemented through the provision of APZs. APZs will

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



be contained within road reserves, and through internal lot setbacks (where applicable). These areas will be maintained to an APZ standard in accordance with Clause 2.2.3.2 of AS 3959.

- Where within the proponent's landholding, the proponent will maintain areas within 100 m of the development to a low threat standard in accordance with Clause 2.2.3.2 of AS 3959.
- An interconnected public road network will be provided within the development to facilitate the movement of people and emergency appliances, with access to Carslake Grove to the north and Tektite Way to the south, which will ensure at least two different vehicular access routes are available to all residents/the public at all times. One cul-de-sac is proposed in the LSP will be developed to standards in accordance with the Guidelines (detailed in Table 4).
- Providing a reticulated water supply and fire hydrants (to Water Corporation standards), which is a typical requirement of urban development, to ensure emergency services are able to respond to a bushfire event.

This BMP sets out the roles and responsibilities of the developer/s, future residents and the City of Stirling. It is important that the measures and procedures outlined in this BMP are adopted across the subdivision and dwelling construction approvals processes.

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455 (Lot 2) North Beach Road, Gwelup



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Appendices

Appendix A

Local Structure Plan (Rowe Group 2017)

Appendix B

Vegetation Photo Points

Appendix C

Compliance Checklist

1 Introduction

1.1 Background

Darron Banyham (the proponent) proposes to develop 455 (lot 2) North Beach Road, Gwelup for residential land uses. This area is herein referred to as “the site. The site is 3.4 ha in area, and is located approximately 12 km north-west of the Perth Central Business District, within the City of Stirling as shown in **Figure 1**. The site is zoned “Urban deferred” under the Metropolitan Region Scheme (MRS) and “Development” under the City of Stirling’s Local Planning Scheme (LPS) No. 3. The site is bound by North Beach Road to the west, Carslake Grove to the north, Careniup Swamp to the east, and future residential areas (currently being developed) to the south.

The site is currently identified as a “Bushfire Prone Area” under the state-wide *Map of Bush Fire Prone Areas* released by the Office of Bushfire Risk Management (OBRM 2016), as shown in **Plate 1** below. The identification of Bushfire Prone Areas within any portion of the site requires further assessment of the bushfire hazard implications on proposed development to be undertaken in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2017) (the Guidelines).



Plate 1: Areas within and surrounding the site identified as “Bushfire Prone Areas” (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2016).

1.2 Aim of this document

The objective of this BMP is to support the residential development of the site in accordance with the structure plan layout attached in **Appendix A**, and to enable bushfire management issues (such

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



as location, siting, vehicle access and water supply) to be addressed as part of the planning process and also through future development approval (if required) and building licence processes.

This BMP addresses the requirements of *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015), the Guidelines (WAPC and DFES 2017) and *Australian Standard 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2009).

This BMP includes:

- An assessment of classified vegetation and associated bushfire hazard levels in the vicinity of the site (within 100 m) and consideration of hazards that will exist in the post development scenario.
- Identification of how the development will achieve the performance principles of the Guidelines by ensuring:
 - Development can be located, sited and designed to ensure that any bushfire hazard does not present an unreasonable level of risk to life and property (i.e. BAL-29 is not exceeded), supported by an indicative Bushfire Attack Level (BAL) assessment. Where applicable, this includes consideration of Asset Protection Zone (APZ) requirements.
 - Vehicular access to and egress from the development is safe if a bushfire occurs.
 - Water is available to the development, so that life and property can be protected from bushfire.
- An outline of the roles and responsibilities associated with implementing this BMP (see **Section 5**).

1.3 Accreditation

This BMP has been prepared jointly by Emerge Associates and Bushfire Safety Consulting.

Bushfire Safety Consulting is owned and operated by Rohan Carboon, an experienced bushfire consultant to the urban planning industry. Rohan has undergraduate degrees in Environmental Management and postgraduate qualifications in Bushfire Protection and has been providing bushfire risk and hazard assessment and mitigation advice to the urban planning and development industry for more than six years. He first worked professionally in community bushfire safety education in 1999 and has been involved in land management including bushfire suppression since 1993.

Bushfire Safety Consulting is a Corporate Bronze Member of the Fire Protection Association of Australia. Rohan is in the process of obtaining BPAD Level 3 BAL Assessor accreditation under the Fire Protection Association of Australia's new Western Australian accreditation scheme.

Emerge Associates has been working jointly with Bushfire Safety Consulting for more than four years to undertake detailed bushfire assessments to support the land use development industry. Emerge Associates' personnel have undertaken BPAD Level 1 BAL Assessor training and are in the processes of seeking accreditation. Emerge Associates will progress to Level 2 accreditation as the Western Australian system is developed.

1.4 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a bushfire management plan.

1.4.1 *Fire and Emergency Services Act 1998*

Areas within Western Australia have been designated as bushfire prone by the Fire and Emergency Services (FES) Commissioner, through the release of the *Map of Bush Fire Prone Areas* (OBRM 2016 or as updated). The *Fire and Emergency Services Act 1998* (FES Act) enables the statutory delineation of Bushfire Prone Areas, which are areas within 100 m of classified bushfire prone vegetation. In turn, Bushfire Prone Areas enable the implementation of the regulations and guidelines outlined below. The *Map of Bush Fire Prone Areas* (OBRM 2016) as currently mapped for the site is shown in **Plate 1**.

1.4.2 *Bush Fires Act 1954*

The *Bush Fires Act 1954* (Bush Fires Act) sets out provisions to reduce the dangers resulting from bushfires, prevent, control and extinguish bushfires, and for other purposes. The Bush Fires Act addresses various matters including prohibited burning times, enabling Local Government to require landowners and/or occupiers to plough or clear fire breaks to control and extinguish bushfires and to establish and maintain bushfire brigades.

Pursuant to the Bush Fires Act, the City of Stirling publishes annual firebreak advice that can be accessed from: <https://www.stirling.wa.gov.au/Services/Health-and-safety/Pages/Fire-safety.aspx>

1.4.3 *Planning and Development (Local Planning Scheme Amendment) Regulations 2015*

The *Planning and Development (Local Planning Scheme Amendment) Regulations 2015* (Government of WA 2015) (the Regulations) include deemed provisions which reference the FES Commissioner's power to designate bushfire prone areas, and provide a mechanism to apply *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015) and the related assessment requirements through planning and development decisions.

1.4.4 *Building Regulations 2012*

All building work in Western Australia is required to comply with the requirements of the Building Code of Australia (BCA). The Building Regulations 2012 recognise that properties that are located within designated bushfire prone areas (within the *Map of Bush Fire Prone Areas*) may require additional assessment for bushfire risk and for construction of dwellings to be in accordance with *Australian Standard (AS) 3959-2009 Construction of buildings in bushfire prone areas* (Standards Australia 2009).

1.4.5 *State Planning Policy 3.7 Planning in Bushfire Prone Areas*

The Department of Planning and WAPC have released *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (December 2015) (SPP 3.7). SPP 3.7 aims to:

- Avoid any increase in the threat of bushfire to people, property and infrastructure. The preservation of life and the management of bushfire impact are paramount.
- Reduce vulnerability to bushfire through the identification and consideration of bushfire risks in decision-making at all stages of the planning and development process.
- Ensure that higher order strategic planning documents, strategic planning proposals, subdivision and development applications take into account bushfire protection requirements and include specified bushfire protection measures.
- Achieve an appropriate balance between bushfire risk management measures and, biodiversity conservation values and landscape amenity, with consideration of the potential impacts of climate change.

SPP 3.7 makes provision for further detailed bushfire hazard assessment to be undertaken for areas identified as bushfire prone within the *Map of Bush Fire Prone Areas* (OBRM 2016, or as updated). It also outlines the information that is required to support the various stages of planning and the potential for bushfire conditions to be applied through the subdivision process.

1.4.6 Guidelines for Planning in Bushfire Prone Areas (WAPC and DFES 2017)

The Guidelines (WAPC and DFES 2017) have been prepared by the WAPC and DFES, to assist in the interpretation of SPP 3.7 and provide advice on planning, designing or assessing a proposal within a bushfire prone area. The Guidelines are the predominant document to be used by decision-making authorities and referral agencies when considering the appropriateness of strategic planning proposals, subdivisions, and development applications.

The Guidelines address important bushfire risk management and planning issues and outline performance criteria and acceptable solutions to minimise the risk of bushfires in new subdivisions and developments. The Guidelines also address management issues including location, siting and design of the development (and consideration of Bushfire Attack Level (BAL) ratings), vehicular access and water requirements.

1.4.7 Australian Standard AS 3959 – 2009 Construction of buildings in bushfire prone areas

The Australian Standard *AS 3959-2009 Construction of buildings in bushfire prone areas* (AS 3959) specifies requirements for the construction of buildings in bushfire prone areas in order to improve their resistance to bushfire attack from embers, radiant heat, flame contact, and combinations of these attack forms.

The objective of AS 3959 is to provide detailed methods for assessing bushfire attack and to prescribe specific construction details for buildings to reduce the risk of ignition from a bushfire, appropriate to the:

- Potential for ignition caused by burning embers, radiant heat or flame generated by a bushfire.
- Intensity of the bushfire attack on the building.

Two separate methods are outlined in AS 3959 for determining the impact of bushfire on dwellings and have been outlined below:

- **Method 1**, outlined in Section 2 and Appendix A of AS 3959, provides a basic assessment of radiant heat flux levels at various distances from classified vegetation (up to 100 m). This method assumes standard fuel loads for classified vegetation as outlined in AS 3959 and

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considers the effective slope beneath vegetation. This method can be used to determine appropriate setbacks to dwellings to achieve different levels of radiant heat exposure (i.e. BAL-12.5 to BAL-FZ, outlined in **Section 4.1.2.5** of this document).

- **Method 2**, outlined in Appendix B of AS 3959, provides a framework for a more rigorous and site specific assessment of radiant heat flux exposure for a site, involving bushfire engineering analysis and modelling using site specific data (e.g. climate/weather conditions during fire season, actual onsite fuel loads associated with classified vegetation etc.).

Vegetation that does not trigger a BAL assessment (i.e. low threat) according to Section 2.2.3.2 of AS 3959 includes the following:

- a) Vegetation of any type more than 100 m from the site.
- b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
- c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site or each other.
- d) Strips of vegetation less than 20 m wide (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
- e) Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.
- f) Low threat vegetation, including grassland managed in a minimal fuel condition, maintained lawns, golf courses, maintained public reserves and parkland, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and wind breaks.

2 Existing environment

The existing environment of the site has been assessed to determine the potential impacts on bushfire behaviour. The vegetation conditions within and surrounding the site are discussed in **Section 3.3**.

2.1 Topography

Natural topographical contours (DoW 2008) indicate that the site and surrounding area is generally flat with an eastward aspect, with elevation ranging from approximately 6 metres Australian Height Datum (m AHD) in the eastern portion of the site to approximately 11 m AHD in the western portion, as shown in **Figure 2**.

2.2 Land use

The site has been historically used for market garden purposes and is largely cleared of remnant vegetation. The site is zoned Urban Deferred under the MRS and "Development" under the City of Stirling's LPS No. 3. Land uses surrounding the site include residential developments to the north and south, Lake Karrinyup Country Club golf course to the west, and public open space 'POS' to the east.

3 Bushfire context

3.1 Bushfire history

Bushfires are not common in the City of Stirling as the area supports a broad urban land use, and areas of remnant vegetation are generally small and retained within a managed parkland environment. Isolated fires occur from time to time in areas of bushland primarily due to arson. The wetland vegetation east of the site has experienced small fires in the past as has the remnant bushland surrounding Lake Gwelup south of the site. Larger fires that have threatened properties and lives have occurred approximately 3 km west of the site within the Trigg Bushland Reserve.

As land use intensification occurs and urban development replaces rural land and/or areas of native vegetation, bushfire hazards are removed thereby reducing areas that can carry a bushfire. At the same time however, the number of people and assets in the community increases thereby increasing the risk at the bushland interface.

3.2 Bushfire risk

The risk management process described in AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines* is a systematic method for identifying, analysing, evaluating and treating emergency risks.

Bushfire risk is determined by assessing:

- Bushfire hazard (i.e. bushfire prone vegetation)
- Threat level (i.e. proximity of the hazard to assets and people)
- Vulnerability of the asset
- Consequence rating (i.e. a rating for the potential outcome once the 'incident' has occurred)
- Likelihood rating (i.e. the chance of an event).

It is not necessary to undertake a standalone site specific bushfire risk assessment in accordance with AS/NZS ISO 31000:2009 as part of this BMP, as risk has been appropriately considered in the specific context of the Guidelines (WAPC and DFES 2017) and AS 3959.

The vulnerability of assets such as dwellings is impacted by several factors. Some relate to the way a bushfire behaves at a site, others to the design and construction materials in the building and siting of surrounding elements. Infrastructure, utilities and human behaviour are also factors. Leonard (2009) identified the following factors as relevant considerations:

- Terrain (slope)
- Vegetation (overall fuel load, steady state litter load, bark fuels, etc.)
- Weather (temperature, relative humidity and wind speed)
- Distance of building from unmanaged vegetation
- Individual elements surrounding the building that are either a shield or an additional fuel source
- Proximity to surrounding infrastructure
- Building design and maintenance

- Human behaviour (ability to be present and capacity to fight the fire)
- Access to the building and how that influences human behaviour
- Water supply for active and/or passive defence
- Power supply.

Potential bushfire impacts to the site occur primarily from forest vegetation to the west of the site within the Lake Karrinyup Country Club and from wetland vegetation to the east of the site within public landholdings, as discussed in **Section 3.3**.

The bushfire threat for the site has been determined by undertaking a Method 1 BAL assessment to ensure no future dwellings are exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29), as outlined further in **Section 4.1**.

Where buildings are lost, this is likely to occur as a result of their vulnerability to the mechanisms of bushfire attack. Buildings constructed to increased standards under AS 3959 are more likely to survive a bushfire than buildings that do not conform to these construction standards, although building survival is not guaranteed.

The vulnerability of people is determined by several factors, including age, fitness levels, gender, level of preparation, and number of occupants who can actively defend a property.

3.3 Vegetation classification and bushfire hazard assessment

Assessing bushfire hazards takes into account the classes of vegetation within the site and surrounding area for a minimum of 100 m, in accordance with AS 3959. The assignment of vegetation classifications is based on an assessment of vegetation structure, which includes consideration of the various fuel layers of different vegetation types.

The existing site condition vegetation classification across the site and surrounding 100 m are shown in **Figure 3**. The majority of the site has been historically cleared to support agricultural land uses, with remnant vegetation limited to the eastern portion of the site, associated with the Careniup Swamp. Vegetation in this area has been classified as Forest (Class A), Scrub (Class D) and Grassland (Class G), as shown in **Figure 3**. Classified vegetation surrounding the site is restricted to remnant vegetation within the Lake Karrinyup Country Club golf course west of the site, and within the broader Careniup Swamp area east of the site (see **Figure 3**). The bushfire hazard levels associated with classified vegetation within and surrounding the site were determined in accordance with Appendix Two of the Guidelines (WAPC and DFES 2017). Classified Forest, Woodland and Scrub vegetation poses an Extreme bushfire hazard to development, while Grassland vegetation will pose a Moderate bushfire hazard, as shown in **Figure 4**.

The post development site condition vegetation classifications for the site are outlined in **Table 1** below, and shown in **Figure 5**, and show the dominant vegetation types that will remain within the site and surrounding 100 m after development within the site has been completed, and any ongoing fuel management (where applicable). The separate areas of vegetation within and surrounding the site are referred to as "Plots" in **Table 1**, and the locations of these Plots are shown in **Figure 5**.

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Table 1: Post development classified vegetation type and future management (Plots displayed in Figure 5)

Plot number	Post development vegetation classification	Description	Effective Slope	Ongoing Management Assumptions	Photo point (Appendix B)
1	Forest (Class A) AND Exclusion 2.2.3.2(f) (low-threat vegetation)	Forest vegetation within the eastern portion of the site and extending outside the site to the east, comprised of Eucalyptus rudis and Melaleuca raphiophylla over sedgeland of Carex divisa, associated with the Careniup Swamp.	Flat / Upslope	The western portion of this vegetation (within the site) will be removed to form part of a landscaped POS interface with development and will therefore pose a low threat in accordance with Clause 2.2.3.2(f) of AS 3959. The eastern portion of this vegetation (within and east of the site) will be retained in an in an unmanaged state (as shown in Figure 5) and will pose a permanent bushfire risk to the site.	1
2,3	Scrub (Class D) AND Exclusion 2.2.3.2(f) (low-threat vegetation)	Scrub vegetation within the eastern portion of the site and extending outside the site to the east, comprised of open sedgeland of Baumea articulata and Schoenoplectus validus fringing areas of open water, associated with the Careniup Swamp.	Flat / Upslope	The western portion of this vegetation will be converted into managed POS and will form a low threat interface with development. The eastern portion of this vegetation will be retained in an unmanaged state (as shown in Figure 5) and will pose a permanent bushfire risk to the site.	2
4	Grassland (Class G)	Classified Grassland vegetation within the eastern portion of the site and extends east of the site associated with the Careniup Swamp, comprised of various grassy weed species.	Flat / Upslope	Assumed to remain unmanaged and pose a permanent bushfire risk to the site.	3
5	Woodland (Class B)	Woodland vegetation to the south-east of the site associated with the Careniup Swamp.	Flat / Upslope	Assumed to remain unmanaged and pose a permanent bushfire risk to the site.	-
6,8	Forest (Class A)	Forest vegetation to the west of the site contained within Lake Kariinyup Country Club golf course, comprised of Corymbia calophylla with scattered Eucalyptus marginata, Banksia spp. and planted Agonis flexuosa trees over a shrubland of Xanthorrhoea preissii and Macrozamia riedlei over a weed dominated understorey.	Flat / Upslope	Assumed to remain unmanaged and pose a permanent bushfire risk to the site. Note: An existing firebreak occurs on the eastern boundary of the golf course property, between classified vegetation and the North Beach Road reserve (west of the site). This firebreak is classed as an exclusion in accordance with Clause 2.2.3.2(e) of AS 3959, and is assumed to be	4

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Plot number	Post development vegetation classification	Description	Effective Slope	Ongoing Management Assumptions	Photo point (Appendix B)
7			Downslope 0-5°	permanently maintained to this standard.	-
9, 11, 13	Woodland (Class B)	Woodland vegetation to the west of the site contained within Lake Karrynup Country Club golf course. Comprised of scattered Eucalyptus marginata over a shrubland of Xanthorrhoea preissii and Macrozamia riedlei over a weed dominated understorey.	Flat / Upslope	Assumed to remain unmanaged and pose a permanent bushfire risk to the site. Note: An existing firebreak occurs on the eastern boundary of the golf course property, between classified vegetation and the North Beach Road reserve (west of the site). This firebreak is classed as an exclusion in accordance with Clause 2.2.3.2(e) of AS 3959, and is assumed to be permanently maintained to this standard.	5
10			Downslope 0-5°		-
12	Grassland (Class G)	Grassland vegetation to the west of the site contained within Lake Karrynup Country Club golf course. Comprised of weedy grass species with sparse overstorey.	Flat / Upslope	Assumed to remain unmanaged and pose a permanent bushfire risk to the site. Note: An existing firebreak occurs on the eastern boundary of the golf course property, between classified vegetation and the North Beach Road reserve (west of the site). This firebreak is classed as an exclusion in accordance with Clause 2.2.3.2(e) of AS 3959, and is assumed to be permanently maintained to this standard.	-

3.4 Vegetation within public open space

There is one public open space/drainage area proposed within the site, as shown in **Appendix A**. Landscape concept plans will be prepared separately for this area of public open space and drainage as part of development, which will outline the proposed treatments and management of this area. Portion of this area will be designed, landscaped and maintained to a low threat standard in accordance with Clause 2.2.3.2(f) of AS 3959 and will therefore pose no hazard to development within the site. A landscaped interface of 20 m will be provided, consistent with adjacent subdivisions to the south and north, and will provide a managed interface between classified vegetation and the site.

Low threat bushfire standards under AS 3959 can be achieved through the design and landscaping of public open space areas to include the following:

- No areas of retained intact remnant vegetation that are greater than 0.25 ha in size and within 20 m of future dwellings.
- No revegetation works that would create high fuel areas – some revegetation may be accommodated where species are chosen for characteristics such as: low ground cover, low fuel loads, single strips of vegetation no less than 20 m apart, etc.
- Planted or retained mature trees with a managed understorey which may include turfed, mulched or wood chipped areas, irrigated/maintained garden beds etc.
- Reticulated and/or maintained planted garden beds and other similar areas.
- Reticulated turf areas or constructed play areas.
- Drainage basins.

The mitigation of hazards within areas proposed as public open space within the site will be largely addressed through the detailed design of the landscape treatments. The City of Stirling will manage the long term maintenance of the parkland and reserves that fall within public open space and drainage areas following handover of these areas.

3.5 Effective slope

The majority of effective slopes under areas of classified vegetation surrounding the site are effectively flat, with an area of zero to five degrees downslope from the site located to the west of the site, as outlined in **Table 1**. Areas of classified vegetation to the west of the site subject to an effective slope of zero to five degrees downslope are contained within the Lake Karrinyup Country Club (see Plot 7 and Plot 10 in **Table 1** and **Figure 5**), and this slope would influence a bushfire approaching the development, resulting in an increased bushfire risk.

4 Bushfire mitigation strategy

This BMP provides an outline of the mitigation strategies that will ensure that as development progresses, an acceptable solution and/or performance-based system of control is adopted for each bushfire hazard management issue. This approach is consistent with Appendix Four of the Guidelines (WAPC and DFES 2017). The management issues addressed as part of this BMP are:

- Location of the development
- Siting and design of the development
- Vehicular access
- Water supply.

For the proposed residential development of the site, acceptable solutions are proposed for all four management issues in accordance with the Guidelines (WAPC and DFES 2017), and is discussed in **Section 4.1** below.

In addition to the management measures listed below, the proponent will be required to comply with the City of Stirling Firebreak Notice until such a time as development is completed. Future lot owners and residents will also be required to comply with the City of Stirling Firebreak Notice/s.

4.1 Bushfire risk management

As previously discussed, it is not necessary to undertake a standalone risk assessment as per AS/NZS ISO 31000:2009 *Risk management – Principles and guidelines*. Land use planning bushfire risk mitigation and building control strategies are detailed in the following sections and provide responses to the bushfire protection performance criteria outlined in Appendix Four of the Guidelines (WAPC and DFES 2017).

This has involved an 'acceptable solution' approach for addressing the intent of the performance principle as outlined in the guidelines. The compliance checklist is attached as **Appendix C** and the response detailed below

4.1.1 Element 1: Location

4.1.1.1 Intent

To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.

4.1.1.2 Acceptable Solution A1.1 Development location

While development within the site is being progressed within 100 m of areas of Extreme bushfire hazards (as shown in **Figure 4**), development can be sited and designed to manage or mitigate the associated bushfire risk by ensuring that no future dwellings will be exposed to an unacceptable level of radiant heat flux (i.e. BAL-29 is not exceeded). This will be achieved through the provision of Asset Protection Zones (APZ) and increased building construction standards, where required, as discussed further below.

4.1.2 Element 2: Siting and design of development

4.1.2.1 Intent

To ensure the siting and design of development minimises the level of bushfire impact.

4.1.2.2 Background

The site will be subdivided into residential lots, public roads and areas of public open space/drainage, in accordance with the proposed structure plan. Dwellings exposed to any bushfire hazard will be those located within 100 m of permanently retained classified vegetation west of the site.

A BAL assessment has been undertaken as part of this BMP in order to demonstrate that no future residential dwellings within the site are exposed to an unacceptable level of bushfire risk (i.e. greater than BAL-29), and to determine the BAL rating (where applicable) to inform building construction requirements in accordance with AS 3959.

The extent of classified vegetation posing a bushfire risk to the site in the post-development scenario (as shown in **Figure 5**) is restricted to the following main areas:

- Class A Forest, Class B Woodland, and Class G Grassland vegetation within the Lake Karrinyup Country Club to the west of the site
- Class A Forest, Class B Woodland, Class D Scrub and Class G Grassland within and to the east of the site.

4.1.2.3 Building siting and potential management considerations

AS 3959 provides six BAL ratings: BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ. These categories are based on heat flux exposure thresholds. The method for determining the BAL rating for any given site involves a specific assessment of vegetation and of topographic slopes. Each BAL rating is associated with appropriate construction standards that apply as a minimum for buildings in bushfire-prone areas (as per AS 3959).

The categories of BALs have been summarised in **Table 2** below.

Table 2: Summary of BAL ratings, heat flux thresholds and associated construction standards, as outlined within AS 3959

Bushfire Attack Level (BAL)	Classified vegetation within 100 m of the subject building and heat flux exposure thresholds	Description of the predicted bushfire attack and levels of exposure	Construction section (within AS 3959)
BAL-LOW	See Clauses 2.2.3.2	There is insufficient risk to warrant specific construction requirements	4
BAL-12.5	$\leq 12.5 \text{ kW/m}^2$	Ember attack	3 & 5
BAL-19	$> 12.5 \text{ kW/m}^2$ to $\leq 19 \text{ kW/m}^2$	Increasing levels of ember attack and burning debris ignited by windborne embers blown together with increasing heat flux	3 & 6
BAL-29	$> 19 \text{ kW/m}^2$ to $\leq 29 \text{ kW/m}^2$	Increasing levels of ember attack and burning debris ignited by windborne embers blown together with increasing heat flux	3 & 7
BAL-40	$> 29 \text{ kW/m}^2$ to $\leq 40 \text{ kW/m}^2$	Increasing levels of ember attack and burning	3 & 8

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Bushfire Attack Level (BAL)	Classified vegetation within 100 m of the subject building and heat flux exposure thresholds	Description of the predicted bushfire attack and levels of exposure	Construction section (within AS 3959)
		debris ignited by windborne embers blown together with the increased likelihood of exposure to flame	
BAL-FZ	$\leq 40 \text{ kW/m}^2$	Direct exposure to flames from fire front in addition to heat flux and ember attack	3 & 9

4.1.2.4 Methodology and assumptions

This BAL assessment has been undertaken in accordance with Method 1 of AS 3959, as outlined in **Section 1.2.7**. A Method 1 BAL assessment provides a basic assessment of radiant heat flux utilising the standard conditions of AS 3959, and is used to determine the minimum setback required to achieve an acceptable level of radiant heat exposure (i.e. BAL-29).

The criteria used to determine the Method 1 BAL is outlined as follows:

- Designated FDI: 80
- Flame Temperature: 1090
- Slope: Flat/upslope, downslope 0-5
- Vegetation Class: Forest (Class A), Woodland (Class B), Scrub (Class D) and Grassland (Class G), as shown in **Figure 5**.
- Distances from classified vegetation: as per Table 2.4.3 of AS 3959, and shown in **Table 3** below.

In addition to the above, the following key assumptions have informed this assessment:

- As part of the development works a 20 m strip of POS in the eastern portion of the site will separate retained classified vegetation and the road reserve. POS will be managed to a low threat standard in accordance with Clause 2.2.3.2 of AS 3959.
- The developer continues to undertake active fuel load management within any undeveloped portions of the site or their landholdings (within 100m of titled lots), in order to maintain areas surrounding the development area to a low threat standard in accordance with Clause 2.2.3.2 of AS 3959. Fuel management works will continue to be undertaken by the developer prior to and during bushfire season (November to March each year) as required, to ensure the site remains low threat until such a time as the hazard is permanently removed or managed as part of residential development or public open space. Management includes where required slashing of grasses to 100 mm and removal of fallen branches and leaf litter (to maintain 2 tonnes per hectare) and low pruning where required.
- Areas of public open space will be developed in accordance with Liveable Neighbourhoods, the City of Stirling LPS No. 3, local planning policies, and any other mechanism. The detailed design for POS areas is determined in collaboration with the City of Stirling as part of the typical subdivision construction process.
- Areas of classified vegetation (or excluded vegetation) outside the site or the proponent's landholding will remain in their existing condition and the current management regimes will continue to be implemented.

4.1.2.5 BAL assessment outcome

The outcomes of the Method 1 BAL assessment indicate that in the western portion of the site is exposed to BAL-40, as shown in **Figure 6**. Through the accommodation of internal lot APZs no future dwellings will be exposed to a BAL rating greater than BAL-29. The results of the indicative BAL assessments are outlined in **Table 3** below, and the BAL contour map is shown in **Figure 6** which shows BAL ratings resulting from classified vegetation described in **Section 3.3** and **Table 1**.

Table 3 details the setbacks required between buildings and classified vegetation within 100 m of the site, to achieve acceptable BAL ratings (i.e. BAL-29 is not exceeded) and are based on the distances specified within Table 2.4.3 of AS 395. A BAL Contour Map has been provided in **Figure 6** and shows the BAL ratings resulting from classified vegetation as described in **Section 3.3** and **Table 1**.

Table 3: Results of indicative BAL assessment

Vegetation classification	Plot number (as per Table 1 and Figure 5)	Effective slope	Distance from classified vegetation	BAL achieved
Forest (Class A)	1, 6, 8	Flat/upslope	<16 m	BAL-FZ
			16- <21 m	BAL-40
			21 - <31 m	BAL-29
			31 - <42 m	BAL-19
			42 - <100 m	BAL-12.5
			>100 m	BAL-LOW
	7	Downslope 0-5	<20 m	BAL-FZ
			20- <27 m	BAL-40
			27 - <37 m	BAL-29
			37 - <50 m	BAL-19
			50 - <100 m	BAL-12.5
			>100 m	BAL-LOW
Woodland (Class B)	5, 9, 11, 13	Flat/upslope	<10 m	BAL-FZ
			10 - <14 m	BAL-40
			14 - <20 m	BAL-29
			20 - <29 m	BAL-19
			29 - <100 m	BAL-12.5
			>100 m	BAL-LOW
	10	Downslope 0-5	<13 m	BAL-FZ
			13 - <17 m	BAL-40
			17 - <25 m	BAL-29
			25 - <35 m	BAL-19
			35 - <100 m	BAL-12.5

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Vegetation classification	Plot number (as per Table 1 and Figure 5)	Effective slope	Distance from classified vegetation	BAL achieved
			>100 m	BAL-LOW
Scrub (Class D)	2, 3	Flat/upslope	<10 m	BAL-FZ
			10 - <13 m	BAL-40
			13 - <19 m	BAL-29
			19 - <27 m	BAL-19
			27 - <100 m	BAL-12.5
			>100 m	BAL-LOW
Grassland (Class G)	4, 12	Flat/upslope	<6 m	BAL-FZ
			6 - <8 m	BAL-40
			8 - <12 m	BAL-29
			12 - <17 m	BAL-19
			17 - <50 m	BAL-12.5
			>50 m	BAL-LOW

Future dwellings within the site will be subject to the following BAL ratings:

- **BAL-29**, which means there is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to an increased level of radiant heat (AS 3959). The risk is considered to be high. It is expected that the construction elements will be exposed to a heat flux not greater than 29 kW/m². In this case, the recommended construction sections in AS 3959 are 3 and 7.
- **BAL-19**, which means the risk is considered to be moderate. It is expected that the construction elements will be exposed to a radiant heat flux not greater than 19 kW/m². There is a risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat (AS 3959). The recommended construction sections in AS 3959 are 3 and 6.
- **BAL-12.5**, which means the risk is considered to be low. It is expected that the construction elements will be exposed to a radiant heat flux not greater than 12.5 kW/m². There is a risk of ember attack and burning debris ignited by wind borne embers and a likelihood of exposure to radiant heat (AS 3959). The recommended construction sections in AS 3959 are 3 and 5.
- **BAL-LOW**, which means the risk is considered to be very low. Whilst there is still some degree of bushfire risk, it is insufficient to warrant any specific construction requirements under AS 3959.

Lot specific BAL ratings will be determined through a detailed BAL assessment at the subdivision stage and will be certified as part of the building licence process. A Method 2 BAL assessment could be completed at subdivision stage which may result in lower BAL ratings in some areas of the site.

As part of the subdivision process, any lots deemed to be subject to a BAL rating greater than BAL-LOW through the confirmation/certification of BAL ratings, will be subject to a notification pursuant to Section 165 of the *Planning and Development Act 2005* placed on the certificate(s) of title

indicating that the lot is subject to the requirements of a Bushfire Management Plan (i.e. increased construction standards to meet increased BAL ratings).

As no future dwellings exceed BAL-29, additional planning or development approval (in addition to that already required) will not be required to address bushfire considerations.

4.1.2.6 Acceptable solution A2.1: Asset Protection Zone

One of the most important bushfire protection measures influencing the safety of people and property is to create an Asset Protection Zone (APZ) around buildings. The APZ is a low fuel area immediately surrounding a building. Non-flammable features such as irrigated landscapes, gardens, driveways and roads can form parts of an APZ.

Research into land management and house losses during the 'Black Saturday' Victorian bushfires concluded that the action of private landholders who managed fuel loads close to their houses was the single most important factor in determining house survival when compared with other land management practices, such as broad scale fuel reduction burning remote from residential areas (Gibbons *et al.* 2012).

Managing vegetation in the APZ has two main purposes:

- To reduce direct flame contact and radiant heat from igniting the building during the passage of a fire front.
- To reduce ember attack and provide a safer space for people to defend (if required) before, during and after a fire front passes.

In the context of the structure plan, lots in the western and eastern portions of the site will remain bushfire prone due to permanent vegetation retained within adjacent landholdings. Therefore addressing the requirements of an APZ has been considered as part of this BMP, to ensure that in the bushfire risk from nearby fuels is minimised.

As outlined in the Guidelines, an APZ must be wide enough to ensure that the maximum BAL rating for residential dwellings adjacent to classified vegetation will not exceed BAL-29. In the case of Forest (Class A) vegetation to the west of the site with an effective slope of Downslope 0 - 5° (Plot 7 as displayed on **Figure 5**) a minimum 27m setback is required to achieve BAL-29. To achieve this, exposed lots will require a 5m internal front lot APZ, which combined with the existing 20 m North Beach Road reserve and the existing 2 m firebreak adjacent to vegetation, achieves the required 27m setback.

An APZ is defined within the Guidelines as 'a low fuel area immediately surrounding a building'. As shown in **Figure 7**, APZs have been used to demonstrate that the minimum separation required between classified vegetation and residential lots (to ensure BAL-29 is not exceeded) will be achieved. It is noted that this use of APZs does not align exactly with the description of an APZ within the Guidelines, however given the stage of planning and the fact that the ultimate placement of future dwellings within lots are unknown, this method is considered appropriate to demonstrate that BAL-29 is not exceeded. The APZ has been applied at an estate scale for this stage of planning, therefore a perimeter APZ is considered appropriate. APZs have been accommodated within public road reserves that will be maintained to an APZ or 'low-threat' standard, to provide an appropriate

interface with potential bushfire hazards adjacent to the site. Following handover, ongoing maintenance of these areas will be undertaken by the City of Stirling, as outlined in **Section 5**.

A future detailed BAL assessment as well as Local Development Plans (where applicable) will provide greater detail on APZs accommodated from the edge of the built form, which satisfies the requirement of an APZ as defined in the Guidelines, while still providing the required separation from adjacent classified vegetation.

Given the small size of the proposed residential lots, all lots exposed to a BAL rating greater than BAL-29 will need to be maintained to the APZ standards outlined below in order to protect dwellings from ember attack.

The APZ/s must be established and maintained to the following standards as outlined in of Appendix Four of the Guidelines:

- **Width:** minimum width of 27m from Forest vegetation with an effective slope of 0-5° downslope. The majority of this APZ is accommodated within the public road reserve; however 5m of internal front lot setbacks will be required. The APZ in the eastern portion of the site is contained within the road reserve and is at minimum 13m wide.
- **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
- **Objects:** within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.
- **Fine fuel load:** combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at two tonnes per hectare.
- **Trees (>5 m in height):** trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.
- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m² in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

The responsibilities for installing and maintaining APZs within the site are outlined in **Section 5**.

4.1.3 Element 3: Vehicular access

4.1.3.1 Intent

To ensure vehicular access serving a subdivision/development is available and safe during a bushfire event.

4.1.3.2 Background

As outlined within the Guidelines, to achieve the intent, all applicable 'acceptable solutions' must be addressed. Those 'acceptable solutions' applicable to the site are addressed in the following sections.

4.1.3.3 Acceptable solution A3.1: Two access routes

The proposed internal road network of the site is shown in **Figure 5** and **Appendix A**, has direct access to the north and south through Tektite Way which connects to Carslake Grove in the north and Feldspar Parade to the south. Both roads provide access to North Beach Road, which connects to the regional road network. A third access in the east of the site provides egress to the south through Columbite Road.

The road network for the site provides for at least two permanent access options at all times to future residents and emergency response personnel. This will achieve performance principle P3, as outlined in Appendix Four of the Guidelines (WAPC and DFES 2017).

4.1.3.4 Acceptable solution A3.2: Public roads

Surrounding public roads and all new public roads within the site will comply with the minimum standards outlined in Appendix Four of the Guidelines.

4.1.3.5 Acceptable solution A3.3: Cul-de-sac (including a dead-end road)

The development proposes one cul-de-sac in a location where connection to existing roads is not feasible. The proposed cul-de-sac is approximately 75m long and will service four lots, which is in line with the standards required under Appendix Four of the Guidelines. Access will be provided from this cul-de-sac through to existing residential development south of the site, as well as connecting to the broader internal road network as shown in **Figure 7**.

This cul-de-sac within the site will be constructed to, and comply with the minimum standards outlined in Appendix Four of the Guidelines.

4.1.4 Element 4: Water

4.1.4.1 Intent

To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.

4.1.4.2 Acceptable Solution A4.1: Reticulated water

The development is located within an Emergency Services Levy (ESL) Category 1 area, which indicates that career Fire and Rescue service and the SES response services require ready access to an adequate water supply during bushfire emergencies.

The development will be provided with a reticulated water supply, together with fire hydrants that will be installed by the developer/s to meet the standard specifications of Water Corporation (Design Standard DS 63) and DFES. Fire hydrants on land zoned for residential purposes are required to be sited at or within 200 m of residential dwellings (Class 1a). This achieves acceptable solution 4.1 within the Guidelines.

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



The Water Corporation will be responsible for all hydrant maintenance and repairs.

4.2 Public education

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The publication *Prepare. Act. Survive.* (DFES 2014) provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from

<http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx>.

The City of Stirling provides bushfire safety advice to residents available from their website

<https://www.stirling.wa.gov.au/Services/Health-and-safety/Pages/Fire-safety.aspx>

Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high risk areas.

Future residents of the site are able to access additional bushfire information via the above sources, or through contacting the City of Stirling or DFES directly. In the case of a bushfire in the area, advice would be provided to residents by DFES, Department of Parks and Wildlife (DPaW) and/or the City of Stirling on any specific recommendations to responding to the bushfire, including evacuation if required.

5 Implementing the Bushfire Management Plan

Table 4 outlines the future responsibilities of the developer, future lot owners or residents, and the City of Stirling associated with implementing this BMP. These responsibilities can be enforced through the City of Stirling firebreak notice.

The future owners/occupiers of lots within the site, as created through future subdivision stages, are responsible for maintaining a reduced level of risk from bushfire within their properties (where applicable), and will be responsible for undertaking, complying and implementing measures to protect their own assets (and people under their care) from the threat and risk of bushfire.

Table 4: Responsibilities for the implementation of the BMP

Management action	Timing
Developer/s	
The assessment recommendations are to be submitted to the City of Stirling and accommodated in the lot clearances and/or Local Development Plan outcomes.	To support the creation of lot titles ¹
For each new lot created within areas exposed to a BAL rating exceeding BAL-LOW, lodge a Section 165 Notification on the Certificate of Title in order to alert purchasers and successors in title of the existence of the overarching BMP and specifically the requirements associated with meeting AS 3959 construction standards.	To support the creation of lot titles ¹
Install the public roads to standards outlined in Section 5.1.3 and ensure two access ways (either formal road or temporary emergency access) are provided at all times for each subdivision stage.	To support the creation of lot titles ¹
Install POS in accordance with the approved landscape design and maintain for two years from practical completion (or as required by the City of Stirling).	To support the creation of lot titles ¹ and/or as part of subdivision and development
Reticulated water supply and hydrants to be installed as per standard Water Corporation requirements, unless otherwise agreed.	As part of subdivision and development
Make a copy of the BMP available to each lot owner subject to AS 3959 construction standards.	During the lot sale process, and ongoing as required
Areas within 100 m of staged development (within the proponent's landholding) will be cleared of vegetation or managed to a low threat vegetation standard (in accordance with Clause 2.2.3.2 of AS 3959) unless assumed otherwise (ensuring that BAL-29 is not exceeded). This includes grazing or slashing of grasses, and removal of surface and near surface fuels (such as leaf litter and dead branches), where required immediately prior to and during the bushfire season (November to March annually).	Ongoing, where applicable
On all vacant balance land, comply with the City of Stirling firebreak notices as published.	Ongoing, where applicable
Property owner/occupier	
Where APZs are indicated within lots, APZs must be maintained in accordance with AS 3959 standards	As part of building design and construction
Ensuring construction of dwelling/s complies with AS 3959 where a BAL rating greater than BAL-LOW is applicable, as detailed within the certified BAL assessment that will be completed prior to the creation of lot titles. The certified BAL ratings can be used to determine the appropriate building construction standard.	As part of building design and construction
If dwellings are subject to additional construction in the future, such as renovations,	As part of building design and

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



Management action	Timing
AS 3959 compliance is required if applicable (i.e. where located within a designated bushfire prone area).	construction
Ensuring that their property complies with the City of Stirling firebreak notices as published.	Ongoing, where applicable
Consider maintaining each property in good order to minimise bushfire fuels in accordance with the requirements outlined in this BMP, see Section 4.1.2.6 .	Ongoing, where applicable
Ensuring that where hydrants are located, they are not obstructed and remain visible at all times.	Ongoing, where applicable
City of Stirling	
Providing fire prevention and preparedness advice to landowners upon request, including the <i>Homeowners Bush Fire Survival Manual: Prepare, Act, Survive</i> (or similar suitable documentation) and the City of Stirling firebreak notice.	Ongoing, as required
Monitoring vegetation fuel loads in public road reserves and liaising with relevant stakeholders to maintain fuel loads at minimal fuel levels.	Ongoing, as required
Maintaining public road reserves to appropriate standards and ensuring compliance with the City of Stirling firebreak notices.	Ongoing, as required
Maintaining public open space to appropriate low threat vegetation standards in accordance with Clause 2.2.3.2 of AS 3959 following handover by the developer.	Ongoing, as required
Department of Fire and Emergency Services (DFES)	
DFES emergency fire personnel are responsible for responding to emergency situations relating to bushfire within the City of Stirling. Where bushfire threatens the site, the local brigade will utilise the internal road network of the site to protect life and property.	Ongoing, as required.
Water Corporation	
The Water Corporation is responsible for the ongoing maintenance and repair of water hydrants.	Ongoing, as required

¹ To support creation of lot titles, evidence will be provided that the action outlined has been addressed, or agreement on an appropriate alternative has been arranged with the City of Stirling. This will generally be required to support the clearance of subdivision conditions.

6 Summary of bushfire management

The site is located within an area identified as bushfire prone within the state *Map of Bush Fire Prone Areas* (OBRM 2016). This BMP has been prepared consistent with Appendix Four of the Guidelines (WAPC and DFES 2017) and demonstrates that as development progresses, an acceptable solution can be adopted for each bushfire hazard management issue, as summarised below:

- **Location:** as outlined in **Section 4.1.2.5** the BAL assessment indicates that the development (i.e. future dwellings) is located in an area that is or will, on completion, be subject to BAL-29 or below, as shown in the BAL contour map (see **Figure 6**).
- **Siting and Design:** proposed lots will not be exposed to an unacceptable level of radiant flux, without appropriate mitigation measures, such as APZs and/or increased construction standards in accordance with AS 3959. Separation will be provided between dwellings and post-development classified vegetation through the strategic placement of roads, POS and APZs, as indicated in **Figure 7**. The design, construction and ongoing maintenance of POS and landscaped areas to a 'low threat vegetation' standard in accordance with Clause 2.2.3.2 (f) of AS 3959 will ensure that bushfire risk to people, property and infrastructure is minimised. This is initially the responsibility of the developer, with ongoing maintenance the responsibility of the City of Stirling
- **Vehicular Access:** The internal layout, design and construction of public and private vehicular access and egress in the subdivision/ development will be in accordance with the Guidelines, and will allow emergency and other vehicles to move through it easily and safely at all times. The development will provide direct access to Carlslake Grove to the north and Feldspar Parade to the south. The proposed Cul-de-sac will be developed to standards in accordance with the Guidelines.
- **Water:** The development will be provided with a permanent and secure reticulated water supply that is sufficient for firefighting purposes. Fire hydrants will also be installed and will be constructed to Water Corporation standards. These are typical requirements of urban development, to ensure emergency services are able to respond to a bushfire event.

Community bushfire safety is a shared responsibility between state and local governments, fire agencies, communities and individuals. **Table 4** of this BMP outlines the actions which should be implemented, and the parties responsible for their implementation, to reduce the bushfire risk to future residents and the community.

7 Applicant Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:



Name: Jen Longstaff

Company: Emerge Associates

Date: 17 March 2017

Signature:



Name: Rohan Carboon

Company: Bushfire Safety Consulting

Date: 19 June 2015

1 References

1.1 General references

- Department of Fire and Emergency Services (DFES) 2014, *Prepare. Act. Survive.*, Perth.
- Gibbons, P., van Bommel, L., Gill, A., Cary, GJ, Driscoll, D., Bradstock, R., Knight, E., Moritz, M., Stephens, S. and Lindenmayer, D. 2012, *Land Management Practices Associated with House Loss in Wildfires*, PLoS One, 7(1).
- Government of Western Australia (Government of WA) 2015, *Planning and Development (Local Planning Schemes) Regulations 2015*, Perth.
- Standards Australia 2009, *AS 3959-2009 Construction of buildings in bushfire-prone areas*, Sydney.
- Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth, Perth.
- WAPC and DFES 2017, *Guidelines for Planning in Bushfire Prone Areas version 1.1*, Western Australian Planning Commission, Perth.

1.2 Online references

- Bureau of Meteorology (BOM) 2004, Wind Roses, Australian Government, March 2017, http://www.bom.gov.au/climate/averages/wind/wind_rose.shtml
- Department of Water 2008, *LIDAR derived 1 m elevation contours* dataset, Government of Western Australia.
- Office of Bushfire Risk management (OBRM) 2016, Map of Bush Fire Prone Areas, viewed March 2017, <https://maps.slip.wa.gov.au/landgate/bushfireprone2016/>

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



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Figures



Figure 1: Site and Assessment Area

Figure 2: Topography

Figure 3: Existing Conditions – AS 3959 Vegetation Classification




Figure 4: Existing Conditions – Bushfire Hazard Assessment

Figure 5: Post Development Conditions – AS 3959 Vegetation Classification and Effective Slope

Figure 6: Bushfire Attack Level Contour Map

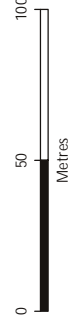
Figure 7: Asset Protection Zone Requirements



-  Site boundary
-  100m assessment area
-  Cadastral boundary

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emerge
ASSOCIATES



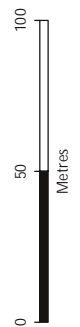
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GDA 1994 MGA Zone 50

Plan Number: EPT5-021(02)-F28
Drawn: DCM
Date: 10/03/17
Checked: VMK
Approved: JL
Date: 17/03/17

Figure 1: Site and Assessment Area

Project: Bushfire Management Plan
455 (Lot 2) North Beach Road, Gwelup
Client: Darron Banyham

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used



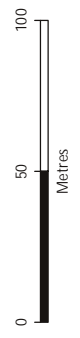
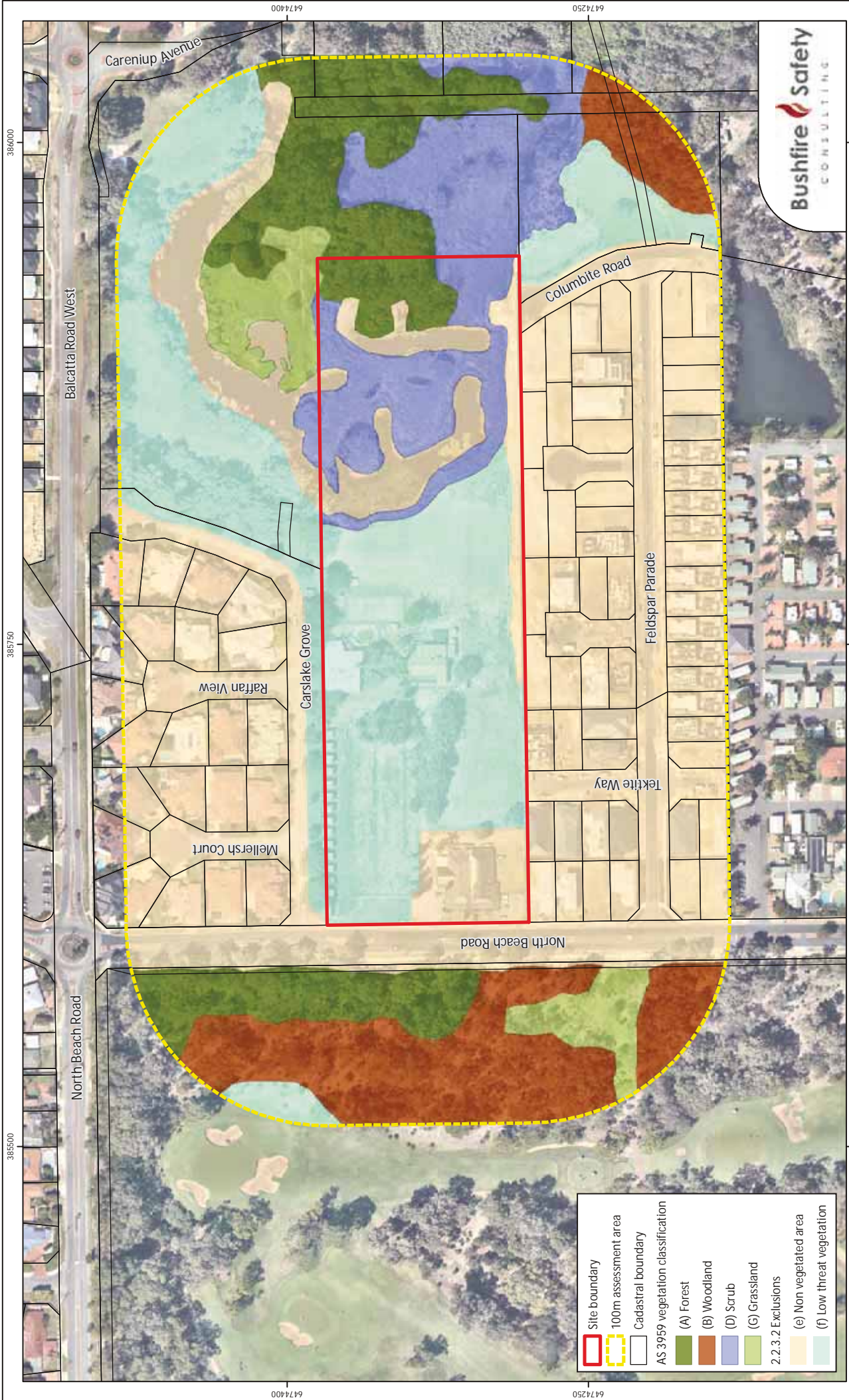
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GDA 1994 MGA Zone 50

Plan Number: EPT5-021(02)-F29
Drawn: DCM
Date: 10/03/17
Checked: VMK
Approved: JL
Date: 17/03/17

Figure 2: Topography

Project: Bushfire Management Plan
455 (Lot 2) North Beach Road, Gwelup
Client: Darron Banyham

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Scale: 1:2,500@A4
GDA 1994 MGA Zone 50

Plan Number: EPT5-021(02)-F30
Drawn: DCM
Date: 10/03/17
Checked: VMK
Approved: JL
Date: 17/03/17

Figure 3: Existing Conditions - AS 3959 Vegetation Classification

Project: Bushfire Management Plan
455 (Lot 2) North Beach Road, Gwelup
Client: Darron Banyham

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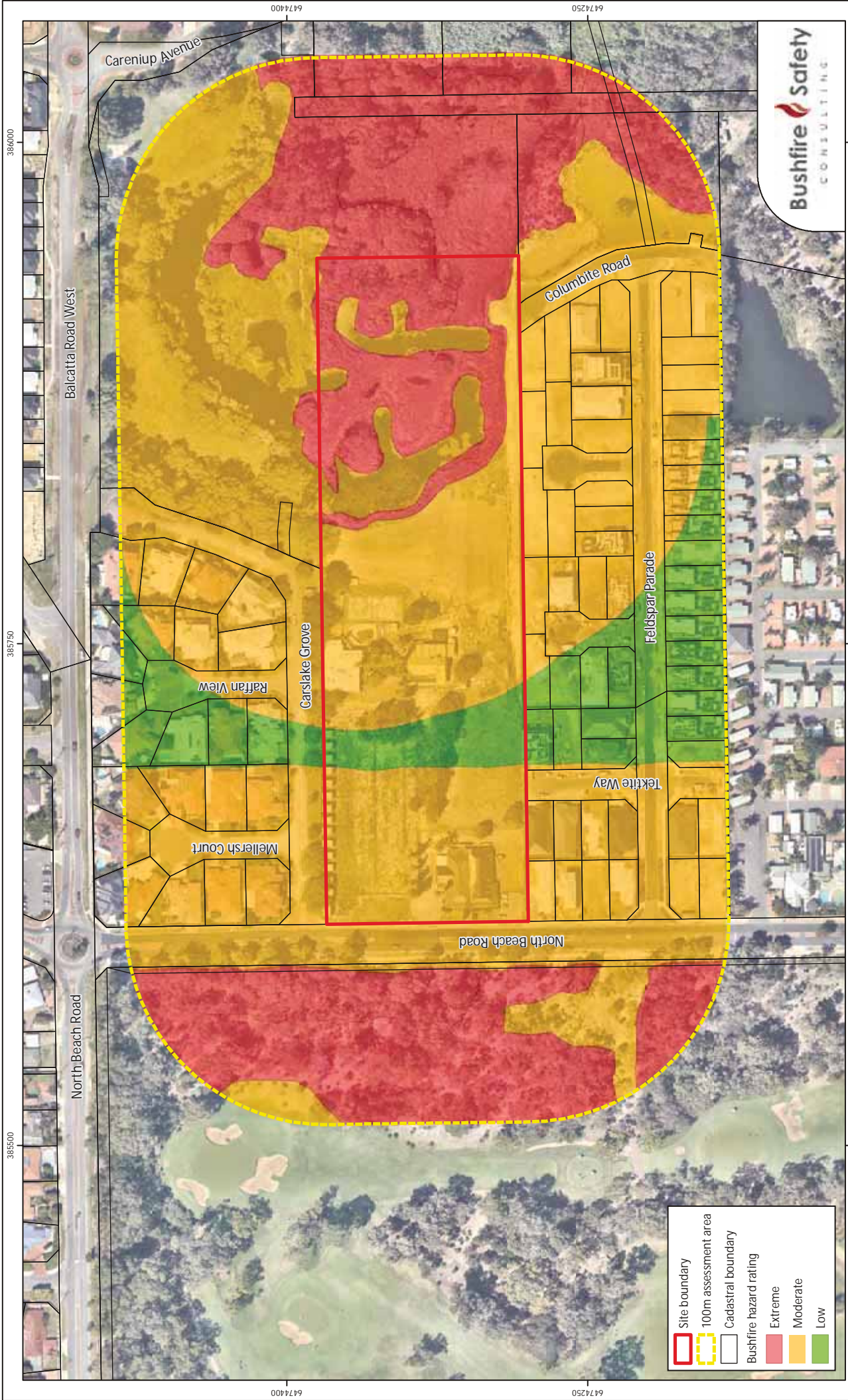


Figure 4: Bushfire Hazard Assessment

Plan Number: EPT5-021(02)-F31
 Drawn: DCM
 Date: 10/03/17
 Checked: VMK
 Approved: JL
 Date: 17/03/17

Project: Bushfire Management Plan
 455 (Lot 2) North Beach Road, Gwelup
Client: Darron Banyham

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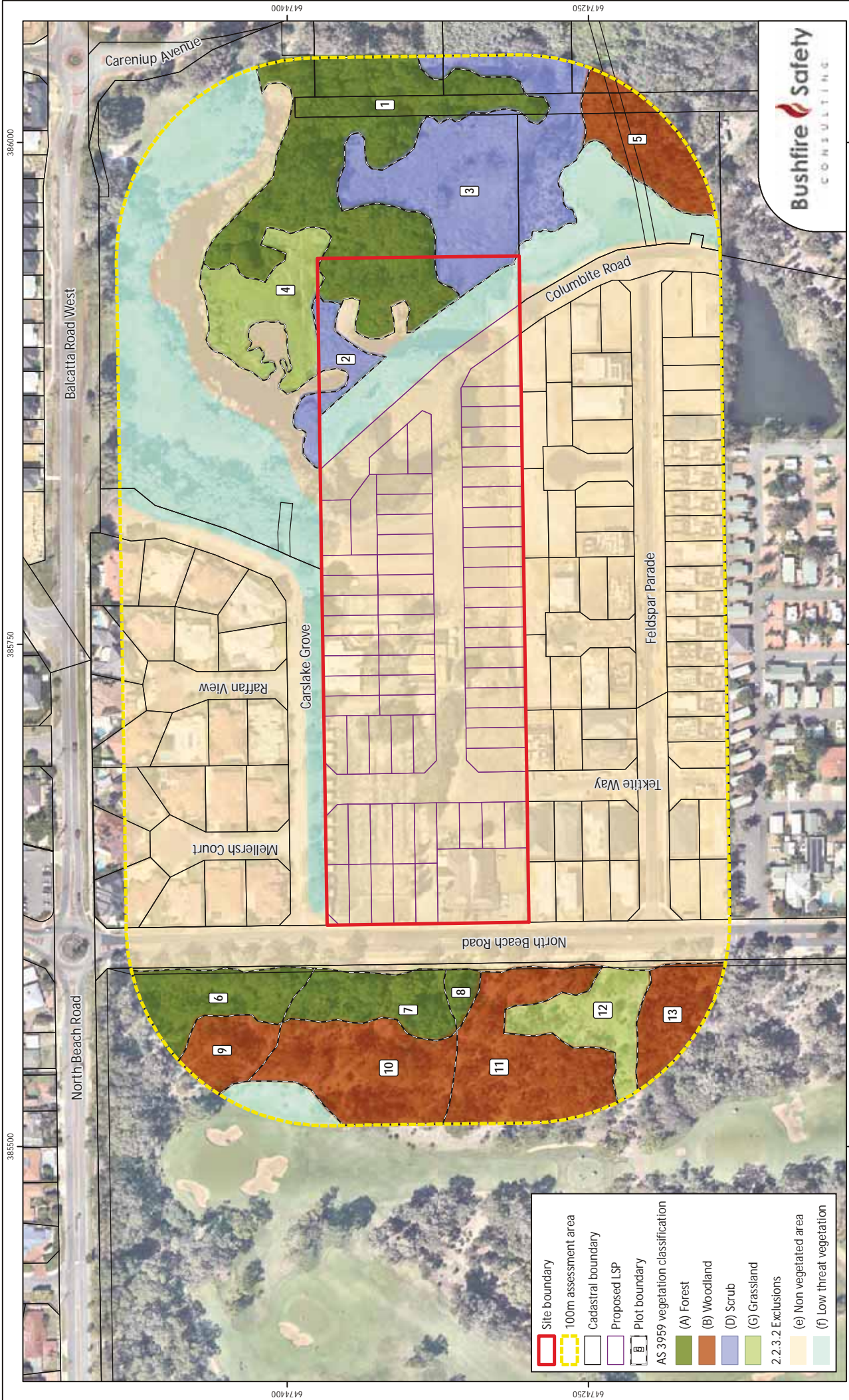


Figure 5: Post Development Conditions - AS 3959 Vegetation Classification

Project: Bushfire Management Plan
455 (Lot 2) North Beach Road, Gwelup

Client: Darron Banyham

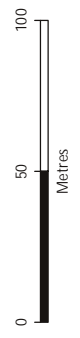
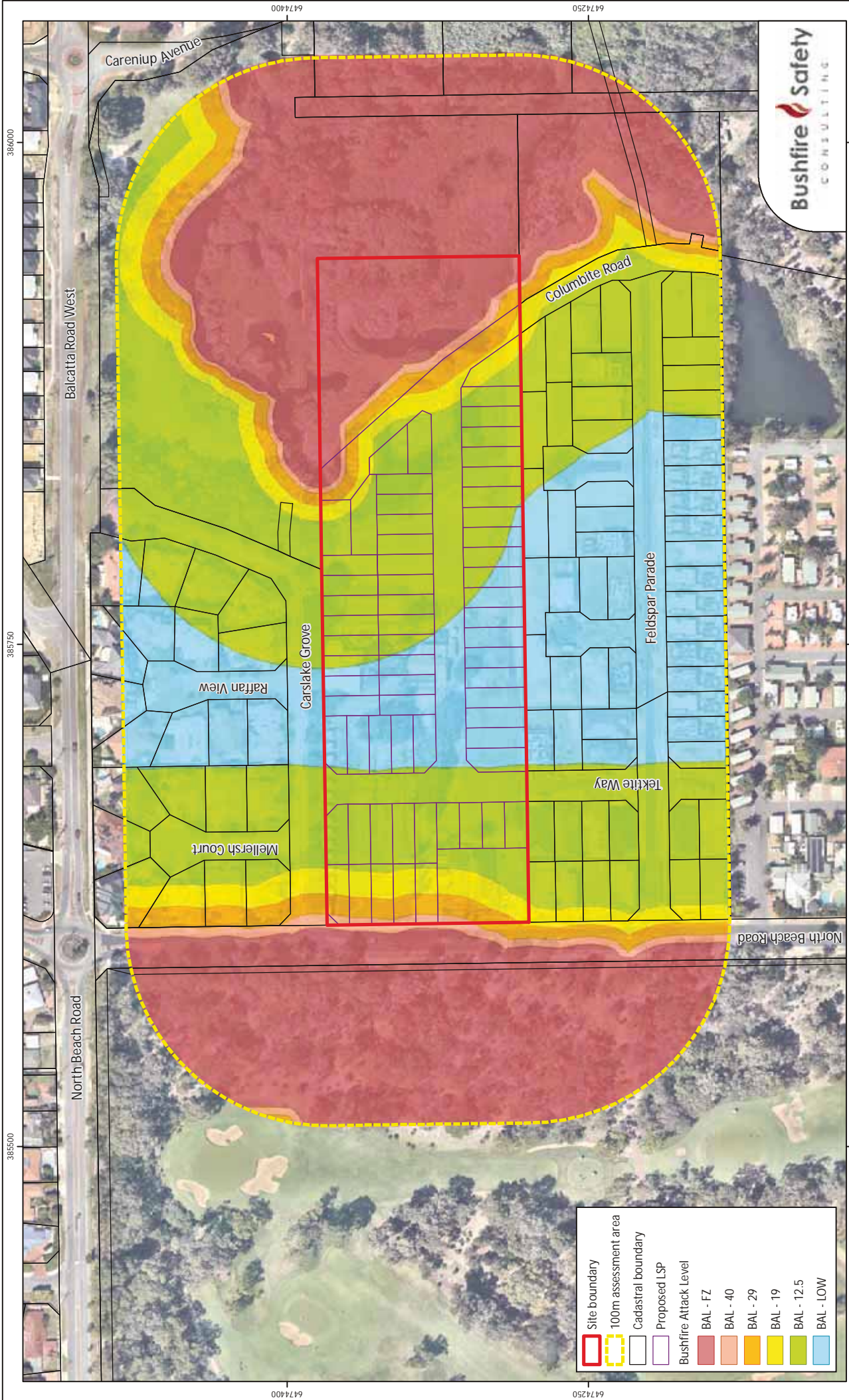
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Drawn: DCM
Date: 10/03/17
Checked: VMK
Approved: JL
Date: 17/03/17

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GDA 1994 MGA Zone 50

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GDA 1994 MGA Zone 50

Plan Number: EPT5-021(02)-F33
Drawn: DCM
Date: 10/03/17
Checked: VMK
Approved: JL
Date: 17/03/17

Figure 6: Bushfire Attack Level Contour Map

Project: Bushfire Management Plan
455 (Lot 2) North Beach Road, Gwelup
Client: Darron Banyham

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- Site boundary
- 100 m assessment area
- Proposed LSP
- Asset Protection Zone

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ASSOCIATES

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Metres
Scale: 1:2,500@A4
GDA 1994 MGA Zone 50

±

Plan Number: EP15-021(N2)-FSA
Drawn: DOM
Date: 10/03/17
Checked: WMK
Approved: JL
Date: 17/03/17

Figure 7: Asset Protection Zone Requirements

Project: Bushfire Management Plan
455 (Lot 2) North Beach Road, Gwelup
Client: Darron Bamyham

While Emerge Associates makes every effort to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used.

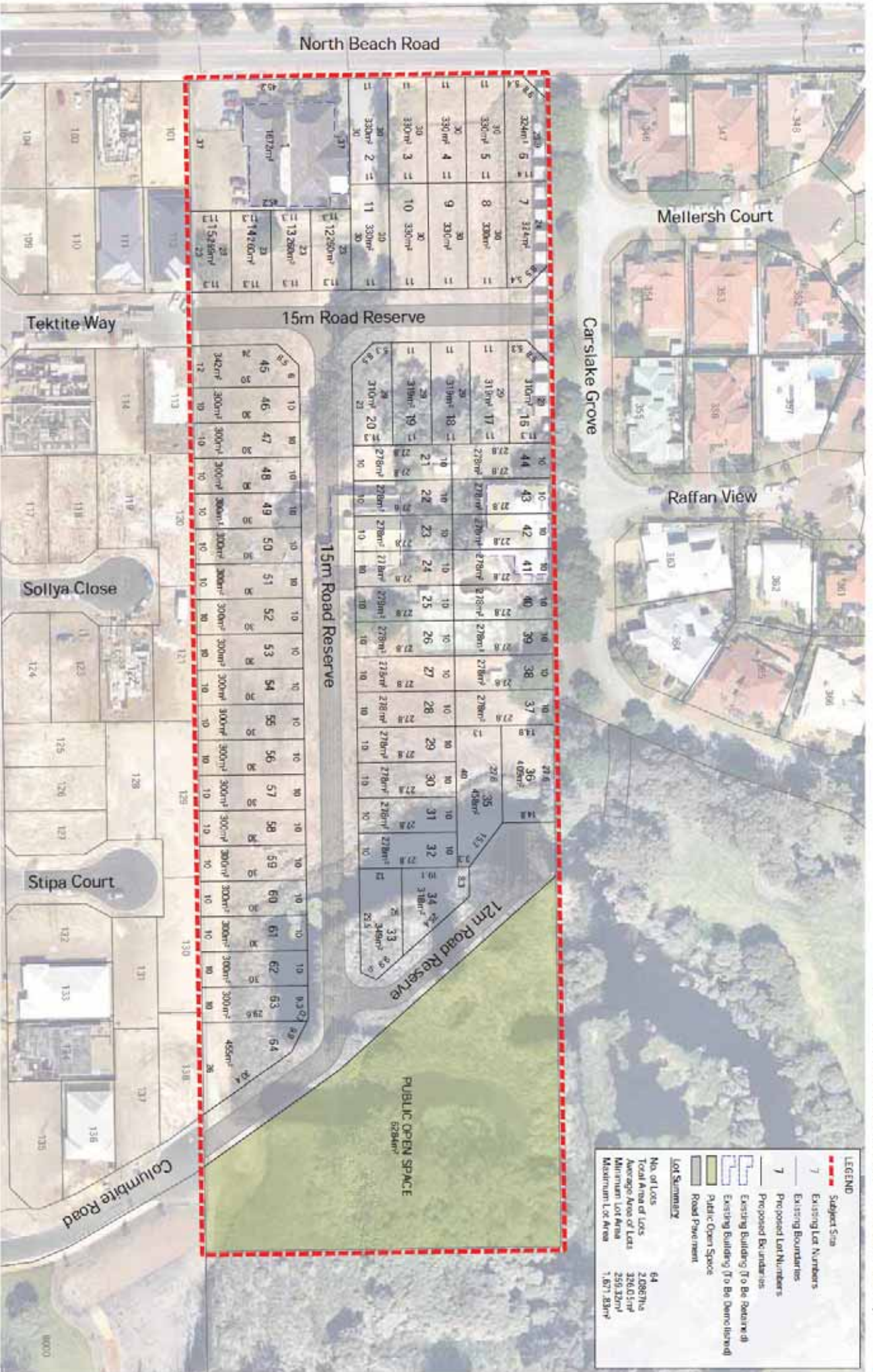
Appendix A

Local Structure Plan (Rowe Group 2017)



Proposed Subdivision

Lot 2 (No. 455) North Beach Road, Gwelup



LEGEND

- - - Subject Site
- Existing Lot Numbers
- Existing Boundaries
- Proposed Lot Numbers
- Proposed Boundaries
- Existing Building (To Be Retained)
- Existing Building (To Be Demolished)
- Public Open Space
- Road Pavement

Lot Summary

No. of Lots	64
Total Area of Lots	2,088.7m ²
Average Area of Lots	32.635m ²
Minimum Lot Area	25.03m ²
Maximum Lot Area	1,671.83m ²

Appendix B

Vegetation Photo Points



Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



Photo point 1: Forest vegetation within Careniup Swamp, east of the site



Photo Point 2: Scrub vegetation within Careniup Swamp, east of the site

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



Photo point 3: Grassland vegetation within Careniup Swamp, east of the site.



Photo Point 4: Forest vegetation and existing firebreak (foreground) within the golf course west of the site

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



Photo point 5: Woodland vegetation west of the site, within the Lake Karrinyup Country Club

Bushfire Management Plan

455 (Lot 2) North Beach Road, Gwelup



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Appendix C

Compliance Checklist



Appendix C: Compliance Checklist

Element/Question	Response	Applicable section of BMP
1: Location		
Does the proposal comply with the performance criteria by applying acceptable solution A1.1 (development location)?	Yes	Section 4.1.1
2: Siting and design of the Development		
Does the proposal comply with the performance criteria by applying acceptable solution A2.1 (asset protection zone)?	Yes	Section 4.1.2
3: Vehicular access		
Does the proposal comply with the performance criteria by applying acceptable solution A3.1 (two access routes)?	Yes	Section 4.1.3.3
Does the proposal comply with the performance criteria by applying acceptable solution A3.2 (public road)?	Yes	Section 4.1.3.4
Does the proposal comply with the performance criteria by applying acceptable solution A3.3 (cul-de-sac)?	Yes	Section 4.1.3.5
Does the proposal comply with the performance criteria by applying acceptable solution A3.4 (battle-axe)?	N/A	N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.5 (private driveway longer than 50 m)?	N/A	N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.6 (emergency access way)?	N/A	N/A
Does the proposal comply with the performance criteria by applying acceptable solution A3.7 (fire services access routes)?	N/A	N/A
4: Water		
Does the proposal comply with the performance criteria by applying acceptable solution A4.1 (reticulated areas)?	Yes	Section 4.1.4.2
Does the proposal comply with the performance criteria by applying acceptable solution A4.2 (non-reticulated areas)?	N/A	N/A
Does the proposal comply with the performance criteria by applying acceptable solution A4.3 (individual lots within non-reticulated areas)?	N/A	N/A



APPENDIX 5

SERVICING & INFRASTRUCTURE REPORT



ROWEGROUP

455 (Lot 2) North Beach Road
Gwelup

Infrastructure Servicing Report



Darron Baynham

Our Ref: SC00188.100

March 2017

INNOVATIVE ENGINEERING SOLUTIONS

SERLING CONSULTING

Serling Consulting (Australia) Pty Ltd
Contract No: SC00181.100
455 (Lot 2) North Beach Road, Gwelup

455 (Lot 2) North Beach Road, Gwelup

Our Ref: SC00181.100

Infrastructure Servicing Report

Rev 1

March 2017

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INNOVATIVE ENGINEERING SOLUTIONS



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Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
A	20/05/2015	G. Alexander	G. Alexander	20/05/2015	Draft
0	22/05/2015	G. Alexander	G. Alexander	22/05/2015	Final
1	13/03/2017	C.Kirk	C.Kirk	13/03/2017	Final - Revised to new Rowe Group Subdiv Layout

Distribution of copies

Revision	Copy no	Quantity	Issued to
0	01	1	Darron Baynham (Client/Developer) Neil Teo (Dynamic Planning)
1	01	1	Darron Baynham (Client/Developer)

Printed:	13 March 2017
Last saved:	13 March 2017
File name:	R01ck 455 North Beach Road 170313 Rev_1
Author:	Calvin Kirk
Project Manager:	Gil Alexander
Name of Organisation:	Darron Baynham
Name of project:	455 North Beach Road, Gwelup
Name of document:	R01ck 455 North Beach Road 170313 Rev_1
Document version:	Rev 1
Project number:	SC00188.100

1. Introduction

1.1 Report Layout and General Advice

Serling Consulting (Australia) Pty Ltd (Serling Consulting) is providing this preliminary infrastructure assessment for the development of 455 (Lot 2) North Beach Road, on behalf of the Darron Baynham (property Developer/Owner). Information provided by the Client's Planner – Rowe Group indicates that the subject landholding is to yield approximately 64 dwellings (proposed lot 1 is an existing vet practice) and this forms the basis of this engineering infrastructure assessment. Appendix A of this report contains the latest proposed subdivision layout by Rowe Group.

The report includes an assessment of the following: -

- Review all available topographical, hydrological, geotechnical, environmental, WAPC planning and servicing reports relevant to the landholding;
- Review all current available servicing planning from the relevant servicing authorities with regards to the applicability of the servicing strategies for the proposed development layouts. The report is laid out as follows: -
 - Section 1 Introduction - Report Layout and General Advice
 - Section 2 Existing Major Infrastructure & Potential Major Infrastructure Requirements

The infrastructure advice provided in this report is preliminary in nature only and subject to change as the development conditions are ratified through the planning and implementation phases of the project. We have discussed the upgrade requirements for the subject site in terms of major infrastructure requirements, including: -

- **Sewer** – requirements for any external upgrade of services, and infrastructure required within the subject site for development of land for residential purposes;
- **Water** – as above for sewer infrastructure;
- **Power** – closest possible location for connection of services, Western Power Feasibility Study;
- **Gas** – expected connection points, provisional sum allocation for connection and extension of external gas supplies to the subject site;
- **Communications** – expected connection point and external connection of services;
- **Roads** – No consideration for the construction of internal roads has been made although it is not considered a risk item;
- **Stormwater** – general requirements for drainage
- **Groundwater** – general discussion on groundwater and site soil conditions from the Perth Groundwater Atlas Maps; and

- **Siteworks** – general discussion on the likely clearing requirements, and any site specific earth working requirements including discussion regarding the likely requirements for site retaining walls.

1.2 Notes Pertaining To This Report

This report has been provided as an input to the overall due diligence concerning the expected infrastructure requirements and the expected engineering issues for mitigation for the development of the aforementioned landholding. This report will be utilised by parties determining the suitability of development at the subject site.

This study has been completed as a desktop analysis, prior to the commencement of any level of detailed engineering design.

The following key point should be considered in the usage of this report: -

- Some feedback has been sought from the various regulatory authorities, however the information received from those authorities is subject to change upon formal application.

1.3 Basis for Forming the Report (Available Information, Reasoning, Literature)

- **Dial Before You Dig (DBYD) Information received** - Serling Consulting have obtained existing infrastructure locations and information through the Dial Before You Dig service. Refer to Appendix C for the project's DBYD data.
- **Geotechnical Investigations & Input** – Serling Consulting has access to two Geotechnical Investigations completed by Prompt Certification (20 March 2013) and CMW Geosciences (29 April 2015). These investigations also contain information gathered from Perth Groundwater Atlas with regard to landfall geology groundwater levels and soil conditions for the subject landholding though the Department of Water's Perth Groundwater Atlas.
- **Hydrology Input - Local Water Management Strategy (LWMS)** - Serling Consulting has access to the site's LWMS completed by Hyd2o (April 2015).
- **Power and Communications Input** – Serling Consulting has liaised with the Developer's preferred Electrical and Communications consultant with regard to servicing the site.
- **Review of Adjacent Lot Design and Construction** – Serling Consulting has liaised with the Civil Engineering Consultant (TABEC) involved in developing Lot immediately south of Lot 455 as 'Thomas Mews Estate'. Correspondingly Serling Consulting understands extent of these new services and infrastructure for consideration in development of Lot 455.
- **Site Visits** – Serling Consulting has conducted numerous visits to the site since being engaged as the developer's civil engineering design consultant.

1.4 Location and Description of the Landholding

The proposed development site comprises an area of approximately 3.34 Ha and is located at Lot 2, 455 North Beach Road, Gwelup, WA as shown in Appendix A.

The site grades gently from approximately RL12m AHD on the Carslake boundary to approximately RL7m AHD within the lower lying swamp lands at the eastern end of the site. It is bound to the west by North Beach Road, to the east by Careniup Avenue, to the north by Carslake Grove, and south by the recently completed Thomas Mews Estate.

Historical aerial imagery shows that the project area and adjacent lots to the north and south were previously used for market gardening for an extended length of time.

The majority of the site is covered in vegetation comprising grass paddocks, large trees and shrubs. The eastern portion of the site is dominated by swamp vegetation including long grass, reeds and trees.

A veterinary clinic (to remain) is present along the western boundary of the site with a residential house and shed occupying the centre of the lot. The existing lake on the eastern section will be filled and will be developed for residential purposes with an access road as shown on the layout in Appendix A.

The development area represents approximately 2.6 ha of the site. The extent of the development area has been established in accordance with the City of Stirling Local Planning Scheme (LPS) No. 3 and associated Careniup Swamp Rehabilitation Plan.



Figure 1: Lot 455 Aerial

2. Existing Infrastructure & Proposed Requirements

This section documents the locations of existing major services infrastructure pertinent to the development of the subject landholding, or which needs to be considered due to the proposed works.

2.1 Existing Sewerage System & Proposed Requirements

Wastewater will be deep sewerage (reticulated) with management by the Water Corporation. Correspondingly Serling Consulting has obtained details of existing infrastructure by a dial before you dig request and initiated discussions with the Water Corporation on potential connection points on Carslake Grove and via the newly developed block immediately south of Lot 455 (Thomas Mews Estate). With this, Serling Consulting have produced a preliminary sewer reticulation plan to be used in submission to Water Corporation upon release of WAPC Conditions (in due course). Lot 455 can be integrated into the system, as shown in Appendix B Sewer Reticulation Plan (C202), via 1 connection point as follows:-

- Connection 1: 150mm sewer main - south-east corner (south end of 'Road 02' / Columbite Road interface)

2.2 Existing Water Supply & Proposed Requirements

Potable water supply to the site will be via the Water Corporation Integrated Water Supply System (IWSS). Correspondingly Serling Consulting has obtained details of existing infrastructure by a dial before you dig request and initiated discussions with the Water Corporation on potential connection points on Carslake Grove and via the newly developed block immediately south of Lot 455 (Thomas Mews Estate). With this, Serling Consulting have produced a preliminary water reticulation plan to be used in submission to Water Corporation upon release of WAPC Conditions (in due course). Lot 455 can be integrated into the system, as shown in Appendix B Water Reticulation Plan (C400), via 3 connection points as follows:-

- Connection Detail 1: 100P-12 water main - Carslake Grove;
- Connection Detail 2: 100P-12 water main - south-west corner (south end of 'Road 01' / Teklite Way interface); and
- Connection Detail 3: 100P-12 water main - south-east corner (south end of 'Road 02' / Columbite Road interface).

2.3 Existing Electricity Supply & Proposed Requirements

The existing Western Power (WP) distribution infrastructure in the vicinity of the site comprises of a 22kV three phase aerial High Voltage (HV) and Low Voltage (LV) network. A HV and LV overhead line runs along the east side of North Beach Rd, on the west side of the development site.

Developments of this size are generally treated as natural load growth of the existing network, and as such, network reinforcement works are not attributable to this type of development. Further the WP NCM Tool reports that significant spare capacity is and will be available in the Zone Substation supplying this area (15-20MVA). From the information available without a feasibility study from WP, the HV network appears to be fed from the nearby Zone Substation on Retford place, only ~1.5km to the west, although we cannot access information on whether this feeder has spare capacity in it or not.

A formal DIP application will need to be made to WP to determine how the new development shall be supplied. The most likely power supply scenario, would be for two new HV cable to pole terminations to be installed at poles on North Beach Road, to create a new HV ring, with two HV cables extending to a new padmount HV substation within the development site. This substation would include a new 22kV/415V transformer to provide LV to reticulate to each lot. It is also possible that other proposed nearby developments may provide a source of HV for a transformer within the development site, this could reduce the amount of HV cable needed within this development site.

The existing powerline on North Beach Road has several poles adjacent to the development site, and WP typically require that these poles and the aerial networks are removed and replaced with new underground networks as part of development works. This is achieved in the same fashion as the works to create the new HV network ring, mentioned above, with two HV pole terminations and a cable network to a new padmount HV substation. However, there are some complications associated with removing the existing power lines, which include replacing existing infrastructure on those poles, reconnecting customer's currently connected to those poles, and finding suitable locations for cable termination poles, which require ground stay wires approx. 7m from the pole. The nature of the properties in the area might make locating poles difficult and might add cost in lengthy cable runs to suitable locations. Also, there appears to be some HV metering equipment on one of the poles, which WP may require to be relocated at the Developer's cost. We note the adjacent development did not remove and underground power lines on North Beach Road to service their estate.

2.4 Existing Telecommunications Supply & Proposed Requirements

The development is within the Telstra Hamersley Exchange Area and approximately 2.4Km from the exchange. Telstra mains conduits exist on the western side of North Beach Road and Distribution pipe on the eastern side of North Beach Road, passing by the proposed development site. Given that a Telstra pillar (P18) is located approximately 100m to the north of the development, on the corner of Balcatta Road and North Beach Road, there is likely adequate capacity to service the new development with telephony services. The new subdivision should also be within ADSL transmission limits and given the availability of ADSL ports, should permit

the provision of broadband to the development. The distribution pipe on the eastern side of North Beach Road would have capacity to support additional cable for the new subdivision, without augmentation, although it is Telstra policy to require head works to the nearest adequately sized infrastructure. If head works were required, then ~120m of P100 conduit may be needed to P18. Telstra only have an obligation to provide telephony, under its Universal Service Obligation, although broadband could be provided at commercial rates, if there were inadequate existing capacity. It is now government policy that Developers contribute to the cost of infrastructure i.e. copper or fibre. It is possible that no Telstra infrastructure costs would apply, should the Developer opt for Telstra infrastructure in the short term.

NBN Co have accepted this project for fibre under the new Telecommunication Infrastructure in New Developments Policy, presumably on the basis of its size and other adjacent projects of viable size i.e. Thomas Mews Estate directly south of Lot 455 which is serviced via NBN.

We recommend NBN Co fibre, on the basis of its superior capability to Telstra copper, and the fact the broadband and telephony, would be provided under an NBN Co fibre solution.

2.5 Existing Gas Supply & Proposed Requirements

The following information has been obtained by a dial before you dig request as per the figures below.

- 80mm-diameter PVC medium pressure gas reticulation main in North Beach Road;
- 50mm-diameter PVC medium pressure gas reticulation main in Carslake Grove;
- 63mm-PE medium pressure gas reticulation main in Teklite Way; and
- 110mm-PE medium pressure gas reticulation main in Columbite Road.

These mains should be sufficient to service the subject landholding. This will need to be confirmed with ATCO Gas during detailed design.

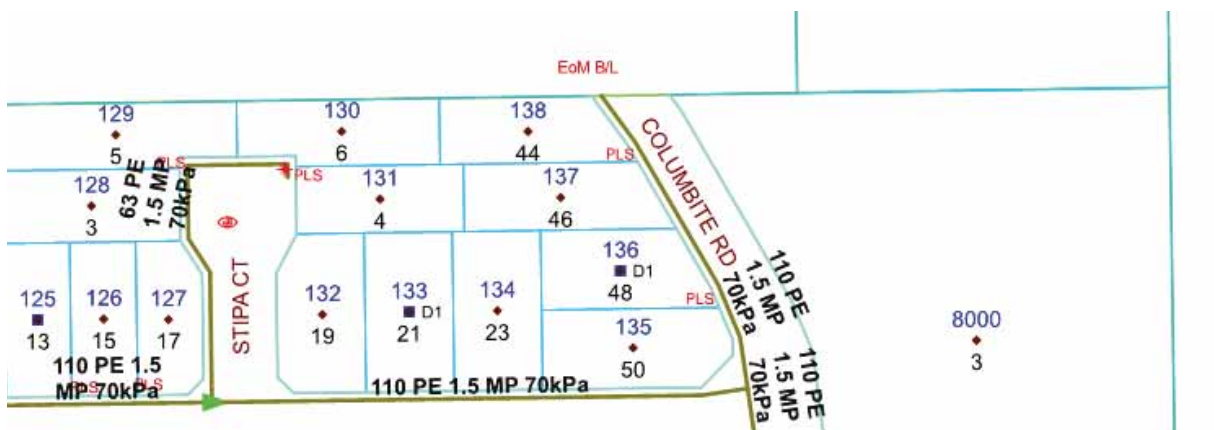


Figure 2: Existing gas in Columbite Road

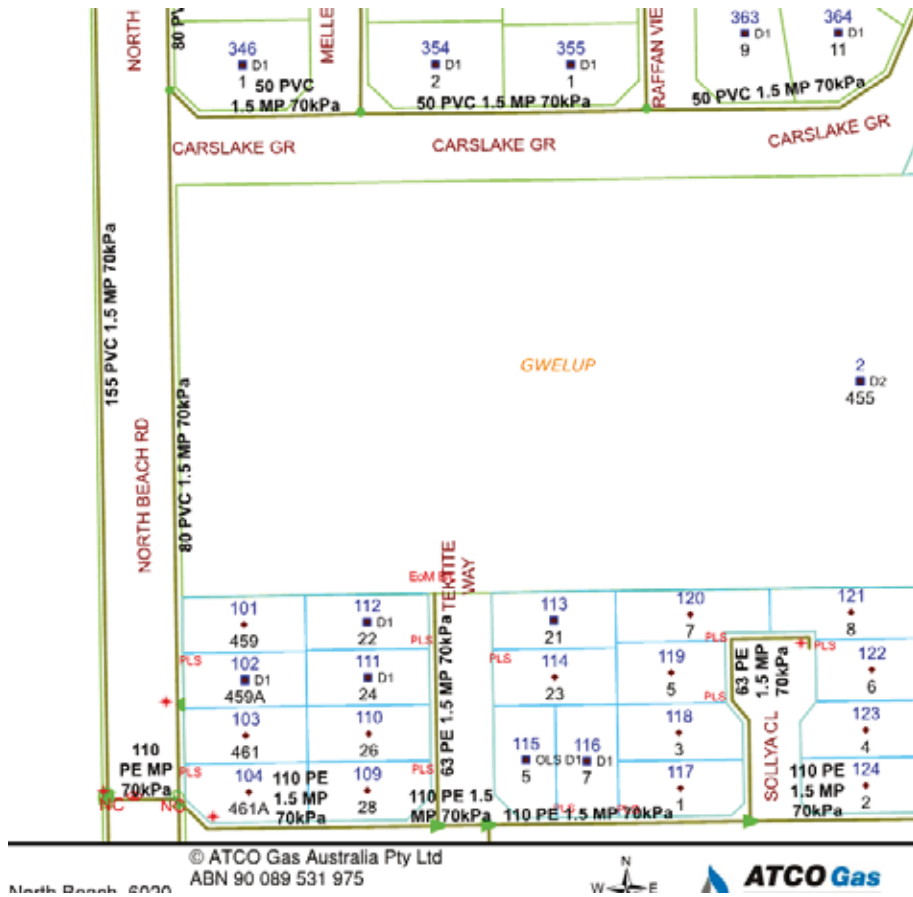


Figure 3: Existing gas in Carlslake Grove & Teklite Way

2.6 Groundwater & Stormwater Drainage Considerations

Groundwater

The Perth Groundwater Atlas suggests groundwater levels seasonally vary from approximately RL5m AHD to RL11m AHD. These levels equate to depths of approximately 1.0m to 1.5m below existing ground levels. Groundwater was encountered at a depth of approximately 1.5m during Geotechnical Investigation by CMW Geosciences which corresponds to the approximate lake groundwater level. It should be noted that the investigation was undertaken during summer months and groundwater levels will be higher after periods of heavy rainfall.

The estimated MGL level for the site in the area adjacent to Careniup Swamp is generally consistent with the maximum recorded groundwater level contours detailed in DoW's online Perth Groundwater Atlas (2014b). Hyd2o maximum groundwater levels adjacent to North Beach Rd are lower than DoW (2014b) estimates, possibly due to irrigation impacts of the Lake Karrinyup Country Club golf course. All subsoil drainage is proposed to be located at the AAMGL as a control groundwater level, with lots provided with a minimum 1.5 m clearance above the invert of the subsoil drains.

A combination of fill and subsoil drainage will be utilised to achieve clearance to groundwater. Subsoil will be free draining and receive appropriate treatment prior to discharge.

Stormwater Drainage Considerations

The Careniup Swamp located to the east, is mapped as a resource enhancement wetland, with a smaller portion mapped as an EPP lake. The swamp forms part of the Water Corporations Main Drainage system, which services the adjacent residential area.

The proposed stormwater management system will retain and infiltrate the 1 in 1 year average recurrence interval (ARI) event on site, with events greater than 1 year ARI overflowing to Careniup Swamp in accordance with Water Corporation overarching drainage planning for the area.

Flood Protection Criteria:-

- No development within wetland core area;
- 100 year overflow to Careniup Swamp;
- Establish minimum habitable floor levels at 0.5m above the 100 year ARI flood level;
- Provide flood paths for overland flows which exceed the capacity of piped drainage.

Serviceability Criteria:-

- Road drainage system designed so roads will be passable in the 1 in 5 year event;
- 5 year overflow to Careniup Swamp.

Ecological Protection Criteria:-

- 1 year 1 hour storm event to be retained on site;
- Use of soakwells at lots scale;
- Total storage volume of 76 m³ and area of 321 m² required to manage flood events up to 1 year ARI, representing approximately 1% of total site area;
- Design accommodates future potential drainage contribution from area to north of the site;
- Bioretention area established at 2% of connected impervious area within 1 year storage area;
- Wetland boundary established in accordance with the Careniup Swamp Rehabilitation Plan contained in City of Stirling (2013).

Appendix B contains Serling Consulting's concept design plan for roads and drainage (C300).

2.7 Earthworks with Geotechnical Considerations

Geological Setting and Soil Profile

Published geological maps (Sheet 2034 Part II and Part of Sheet 2034 III and 2134 III) for the area depict the western portion of the site as being underlain by sands derived from Tamala Limestone (S7) with Peaty Clay Deposits (Cps) occurring towards the east of site.

Based on the results of site investigations, the subsurface profiles encountered on the site generally concurs with the regional geology for the area and comprises of natural sand derived from Tamala Limestone throughout the site.

The eastern end of the site contains very soft organic clays and very loose to loose clayey sands (Swamp Deposits). These deposits are susceptible to significant consolidation settlement under only minor increases in applied pressure. Settlements are likely to occur over a significant time period (several years) which presents potential issues for future movement sensitive structures such as services, buildings and pavements.

Based on the investigation results, up to 3.5m of these Swamp Deposit sediments were encountered beneath the proposed building/road platforms at the eastern end of the Lot. Consolidation settlements associated with the proposed earthfill loads, together with long term creep settlements, have been calculated to exceed normal building tolerances.

As an alternative to excavation and replacement, ground improvement, in the form of wick drains and the construction of temporary surcharge embankments is proposed to over-consolidate the weak sediments and reduce total and differential settlement magnitudes beneath future structures. Further details are provided below.

Surcharging Requirements

Surcharging consists of placing temporary fill embankments to a height that exceeds the design finished surface level. The embankments are then subsequently cut back to the design level following a suitable period of consolidation settlement. The purpose of the surcharging is to ensure that:-

- The magnitude of load applied to the organic layers by surcharging is greater than the design inservice loading thereby ensuring a stiffer reloading response;
- Adequate unloading is achieved following surcharging so that the over-consolidation ratio of the material is increased sufficiently to reduce post construction creep settlements to be within typical performance criteria over the design life of the development.

Surcharge embankment design must consider both primary consolidation settlement and secondary compression (creep) settlement to ensure that post construction creep settlements, following surcharge removal, are within specified performance criteria.

As a preliminary guide, based on a design life of the development of 40 years, up to approximately 2.5m surcharge height is estimated to be required (for a Swamp Deposit material thickness of 3.5m) in order to limit future fill settlements. The surcharge height will be less where the thinner swamp deposits are present.

Surcharging with the incorporation of wick drains is expected to be the most cost effective solution and has been carried out effectively in similar ground conditions previously to consolidate this material prior to development.

Earthworks

Bulk earthworks are required to reach design finished ground surface level. Appendix B contains Serling Consulting's concept design plan for earthworks (C110) with proposed design levels for the subdivision.

Recommendations associated with this work are summarised as follows:-

- Removal of all vegetation and associated root mats;
- All imported fill material required for permanent fill construction or temporary surcharge embankment construction must comprise clean sand fill to meet a grading criteria as follows:
 - It is of a clean granular nature with less than 15% fines content. Where it has a fines content of greater than 15%, it may still be suitable for reuse as an engineered fill material subject to more stringent moisture content controls and use only in suitable (dry) weather conditions;
 - It is free from boulders or particles larger than 150mm and is free from clods, stumps, roots, sticks, vegetable matter or other deleterious materials.
- All permanent fill materials must be moisture conditioned to within +/- 3% of the optimum moisture content, placed and compacted in layers with a suitable roller to achieve a dry density ratio of at least 95% based on Modified compaction (AS1289 5.2.1);
- All surcharge fills must be moisture conditioned and compacted to achieve a unit weight that is consistent with the specified surcharging design requirements.

Site Classification

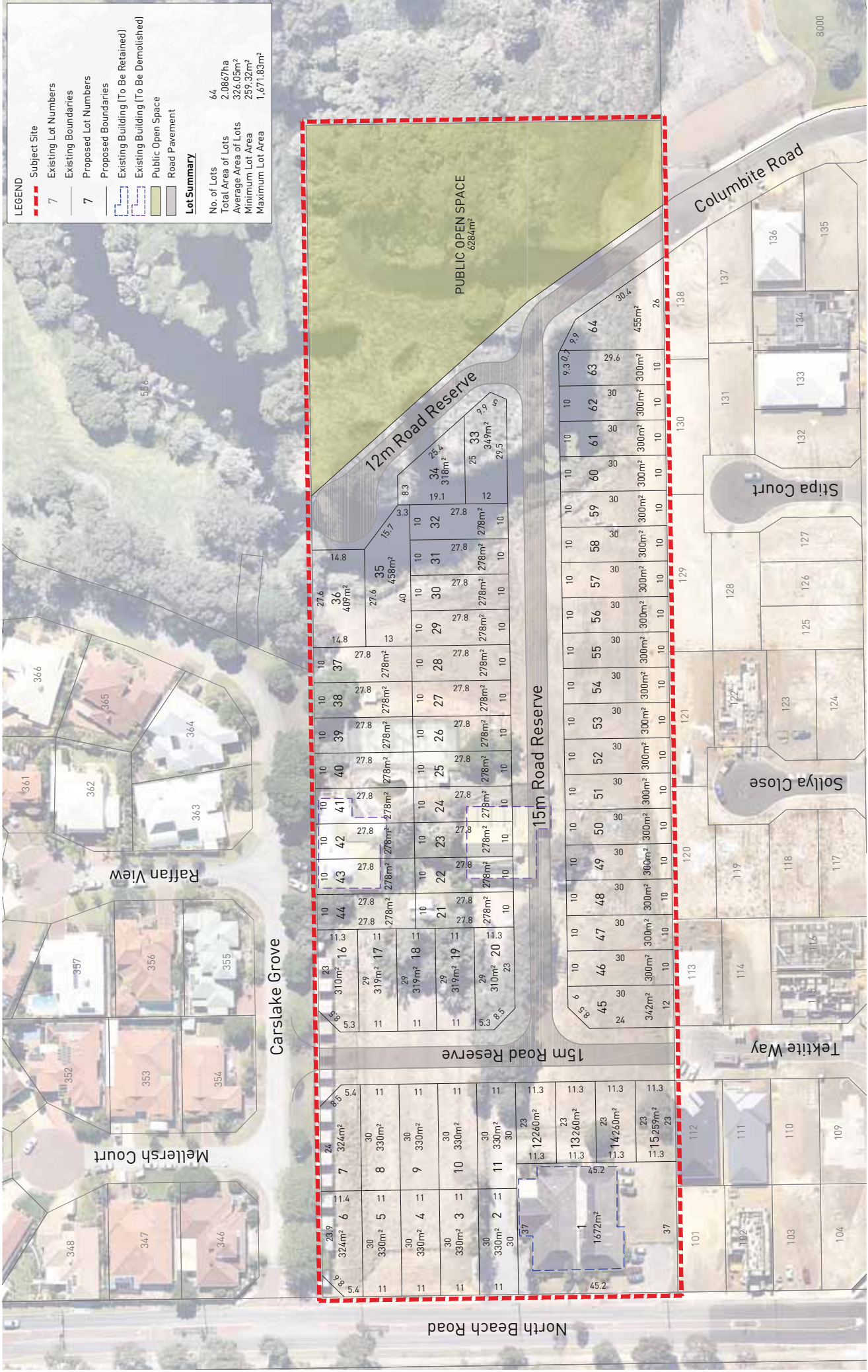
If the remediation recommendations provided herein are carried out, the site may be designed as equivalent to Class A, but no less than Class S, subject to adequate performance specifications (settlement requirements) during the design and construction stages.

Serling Consulting (Australia) Pty Ltd
Contract No: SC00181.100
455 (Lot 2) North Beach Road, Gwelup

Appendix A Proposed Subdivision Layout

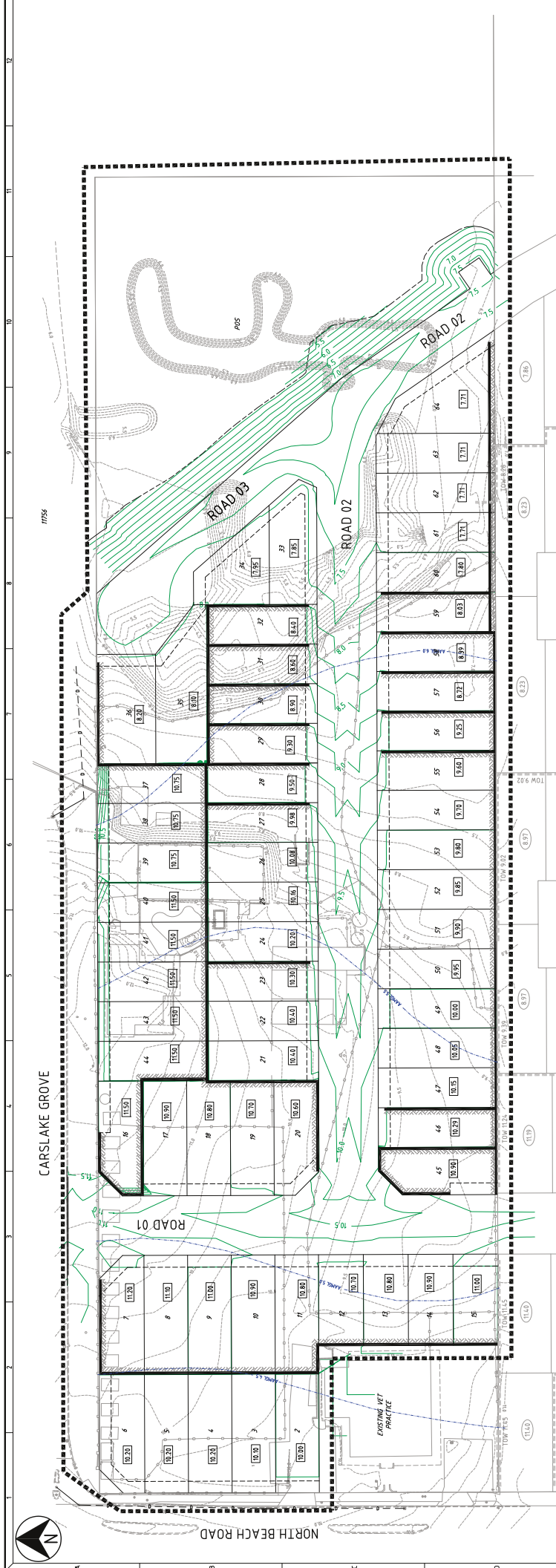
Proposed Subdivision

Lot 2 (No. 455) North Beach Road, Gwelup



Serling Consulting (Australia) Pty Ltd
Contract No: SC00181.100
455 (Lot 2) North Beach Road, Gwelup

Appendix B Preliminary Engineering Drawings



NOTES

- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DRAWINGS AND SPECIFICATION.
- THE CONTRACTOR SHALL REMOVE AND REPOSE ALL MISCELLANEOUS DEBRIS AND BRUSH, CONCRETE PAVEMENT, CURBS, GATES, INTERNAL FENCING, UNSUITABLE MATERIAL ETC FROM WITHIN THE LIMIT OF WORKS SITE.
- THE PLACEMENT OF FILL SHALL NOT COMPROMISE THE GEOTECHNICAL ENGINEER HAS INSPECTED THE WORKS, INCLUDING THE PROOF ROLLING.
- THE CONTRACTOR SHALL MAKE APPROPRIATE ALLOWANCE IN THE DESIGN OF THE EARTHWORKS TO TAKE INTO ACCOUNT ANY APPROVED ALTERNATIVE GEOTECHNICAL ENGINEER TO VISIT THE SITE DURING EARTHWORK ACTIVITIES AS REQUIRED AND MAKE THE NECESSARY REVISIONS TO THE DESIGN UPON COMPLETION OF THE EARTHWORKS.
- THE CONTRACTOR SHALL ALLOW FOR CLEARING, MULCHING AND REMOVAL OF MULCHED MATERIAL.
- THE CONTRACTOR SHALL REMOVE AND STOCKPILE THE TOP SOIL ON SITE OFF SITE UNLESS OTHERWISE DIRECTED DURING CONTRACT NEGOTIATION.
- THE CONTRACTOR SHALL SCREEN THE EXISTING STOCKPILED MATERIAL TO REMOVAL OF ALL DEBRIS AND GEOTECHNICAL ENGINEERS INSPECTION.
- ALL SOIL SHALL BE FREE DRAINING CLEAN GRANULAR MATERIAL AND SHALL BE COMPACTED EXCEEDING 300mm COMPACTED THICKNESS TO 95% MHDD.
- THE CONTRACTOR SHALL ALLOW FOR ROAD BOX-OUT WHEN DESIGNING THE ROAD AND PROVIDE THE NECESSARY DESIGN CONTOURS ON THE DRAWING. REFER TO ROAD PLAN AND PROFILE DRAWINGS FOR WIDTH AND CROSSFALL.
- THE CONTRACTOR SHALL MAKE THEIR OWN DETERMINATION OF THE SUITABILITY OF THE EXISTING SOILS WHICH CAN BE PROVIDED BY SERING CONSULTING IF REQUIRED.
- THE CONTRACTOR SHALL PROOF ROLL ALL FILL AREA'S PRIOR TO THE PLACEMENT OF FILL.
- BATTERS TO EXISTING LEVELS SHALL NOT EXCEED 1 IN 3 SLOPE GENERALLY AND 1 IN 6 IN TIGHTER AREAS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR DUST CONTROL AND ENSURE THAT WORKS COMPLY WITH THE "DUST MANAGEMENT PLAN" - REFER SPECIFICATION.
- THE CONTRACTOR SHALL GIVE NOTICE TO OCCUPYERS OF ANY EXISTING DWELLINGS WITHIN AND AROUND THE PERIMETER OF THE SITE OF THE IMPENDING WORKS AT LEAST 1 WEEK PRIOR TO STARTING THE WORKS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR ARRANGING DILADATION REPORTS FOR ALL EXISTING BUILDINGS WITHIN THE VICINITY OF THE SITE OF WORKS WHICH COULD BE AFFECTED BY THE ACTIVITIES PRIOR TO COMMENCEMENT OF WORKS ON SITE.
- THE CONTRACTOR SHALL HAVE SUFFICIENT WATER CARTS ON SITE SUCH THAT ONE WATER CART IS IN OPERATION AT ALL TIMES.
- THE CONTRACTOR SHALL MAKE NECESSARY ALLOWANCE FOR REINSTATEMENT OF ALL AREAS DISTURBED BY THE WORKS.
- THE CONTRACTOR SHALL MAKE APPROPRIATE ALLOWANCE IN THE DESIGN OF THE EARTHWORKS TO TAKE INTO ACCOUNT ALL BUILDING AS NOTED ON THE DRAWINGS.
- THE CONTRACTOR SHALL ERECT TYPE A WIND FENCING ACROSS THE REAR AND SIDE BOUNDARY OF THE WET CLIMB AND SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF THE ROAD AS NOTATED ON THE DRAWING. FENCING TO BE ERECTED PRIOR TO EARTHWORKS COMMENCING ON SITE.
- THE CONTRACTOR IS MAKE ALLOWANCE FOR ALL SEPTIC TANKS AND SOAKAWAYS WHICH ARE NOT REPRESENTED IN ACCORDANCE WITH THE HEALTH REQUIREMENTS.

LEGEND

- LIMIT OF WORKS BOUNDARY
- EXISTING RETAINING WALLS
- LOT SIDE BEING RETAINED
- PROPOSED RETAINING WALLS
- DESIGN FINISHED LOT LEVEL
- EXISTING CONTOURS
- EXISTING CONTOURS
- LOT NUMBER
- SPOT HEIGHT
- EXISTING TREES TO BE REMOVED
- EXISTING TREES TO BE RETAINED

WARNING
 BEWARE OF UNSTABLE AREAS
 The location of underground cables are shown in this drawing and their exact position is not guaranteed. The contractor is advised to check for the presence of any cables and services before commencement of work, refer to Victorian Regulation 3.21.

DIAL 1100
 BEFORE YOU DIG

PRELIMINARY DRAWING

NOT TO BE USED FOR CONSTRUCTION PURPOSES

NO.	DATE	CHECK	REVISION	DESCRIPTION
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NO.	DATE	CHECK	REVISION	DESCRIPTION
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2				
3				
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6				
7				
8				
9				
10				

CLIENT	DARRON BAYHAM
PROJECT	455 (LOT 2) NORTH BEACH ROAD, GWELOP
DRAWN BY	R. BARGERBOS
CHECKED BY	R. BARGERBOS
DESIGN REVIEW	R. BARGERBOS
REVISION	R. BARGERBOS
APPROVED PROJECT DIRECTOR	

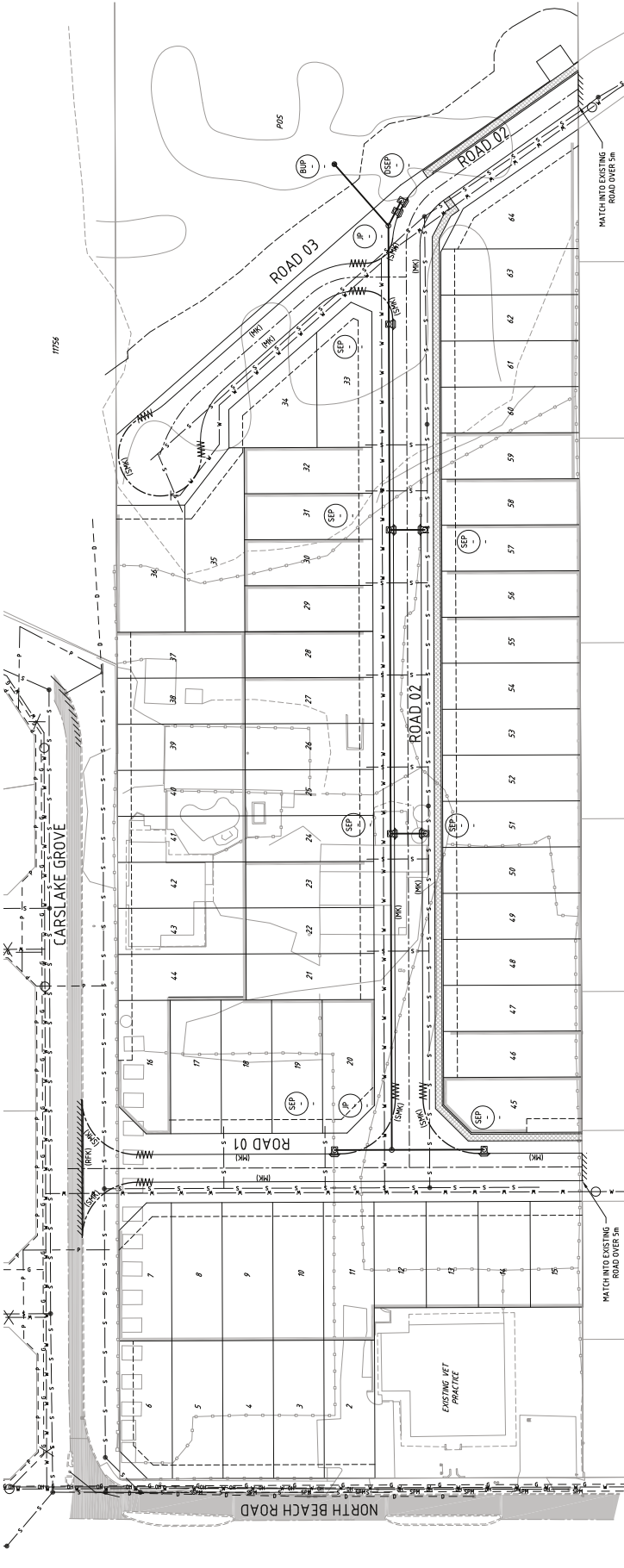
SERING CONSULTING
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SHEET	A1
DATE	15/02/2017
SCALE	1:500
PROJECT NO.	SC00188.100
DRAWING NO.	C10
REVISION	

FILE: BULK EARTHWORKS PLAN



PLAN SCALE 1:500

LEGEND

- (RFK) PROPOSED REINFORCED FLUSH KERB
- (MK) PROPOSED MOUNTABLE KERB
- (SMK) PROPOSED SEMI MOUNTABLE KERB
- (MWT) 2.0m KERB TRANSITION
- EXTENT OF WORKS
- PROPOSED RETAINING WALLS
- STREET SIGNS TO BE SUPPLIED & INSTALLED BY CONTRACTOR AS PER COUNCIL STD DRG ESTER.
- SIGN OUT EXISTING PAVEMENT AND MAKE SMOOTH TRANSITION TO EXISTING PAVEMENT. SEE NOTE 2.6
- (F) PROPOSED 1m FOOTPATH
- (E) EXISTING DRAINAGE
- (S) SEWER
- (T) TELSTRA
- (G) GAS
- (U) UNDERGROUND POWER
- (W) WATER
- (SP) SEWER PRESSURE MAIN
- (DEEP) DOUBLE SIDE ENTRY PIT
- (GP) GULLY PIT
- (GPT) GROSS POLLUTANT TRAP
- (L) PIPE DIA / CLASS IF NOT 75/ GRADE
- (MH) DOWNSTREAM INVERT LEVEL
- (J) JUNCTION PIT
- (SEP) SIDE ENTRY PIT
- (SE) PROPOSED SIDE ENTRY PIT
- (G) PROPOSED GULLY PIT
- (PIT) PIT TYPE
- (PIT NUMBER)
- (PIT CHANGE)
- (L) US 25.00
- (L) 300 / N5
- (L) 6.5
- (L) 24.00
- (R) 150
- (C) 15.0

NOTES

1. GENERAL
 - 1.1. THE CONTRACTOR SHALL LIMIT THE MOVEMENT OF EQUIPMENT AND HANDPOWER TO THE MINIMUM AREA NECESSARY AND PROTECT ALL VEGETATION ON SITE.
 - 1.2. CONTRACTOR SHALL OBTAIN A COPY OF ALL RELEVANT COUNCIL STANDARD DRAWINGS FOR ALL SUBDIVISIONAL WORKS. ALL WORKS SHALL BE CARRIED OUT TO THE REQUIREMENTS OF THE LOCAL AUTHORITY.
2. ROADWORKS
 - 2.1. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE ROAD PROFILES AND THE INTERSECTION DETAILS.
 - 2.2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUBMITTING TRAFFIC MANAGEMENT PLAN TO THE LOCAL COUNCIL FOR APPROVAL. AT LEAST 2 WEEKS BEFORE COMMENCEMENT OF WORKS.
 - 2.3. THE CONTRACTOR SHALL MAKE ALL ALLOWANCES NECESSARY FOR REINSTATEMENT OF ANY AREAS DISTURBED BY THE WORKS TO ORIGINAL CONDITION TO THE SATISFACTION OF THE LOCAL AUTHORITY.
 - 2.4. ALL ROADS TO BE CENTRALLY LOCATED UNLESS NOTED OTHERWISE ON THE DRAWINGS. ROAD CENTRELINE SHOULD BE ELECTRONICALLY AVAILABLE TO CONTRACTOR USING GOOGLE EARTH.
 - 2.5. ALL CORNER SWEEPS SHALL BE 12.0m RADIUS KEPT UNLESS OTHERWISE SHOWN.
 - 2.6. ALL KERBS SHALL BE MOUNTABLE UNLESS OTHERWISE SHOWN. SWEEPS SHALL BE SEMI MOUNTABLE.
 - 2.7. ALL ROAD SURF FINISHES & DISTURBED AREAS SHALL BE STABILISED BY APPLICATION OF ALLUVED SAND OR OTHER MATERIALS.
 - 2.8. ALL STREET NAME PLATES SHALL BE FIXED TO LIGHTING COLUMNS WHERE PRACTICAL.
 - 2.9. FOOTPATHS.
3. DRAINAGE
 - 3.1. DRAINAGE PIPE SHALL BE CLASS 2 R9 UNLESS OTHERWISE NOTED.
 - 3.2. ALL TRENCHING, PIPE BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH AS3725.
 - 3.3. ALL GRATED GULLY PITS WITHIN TRAFFICABLE AREAS AND CYCLEWAYS SHALL HAVE CYCLE-SAFE GRATING.
 - 3.4. ALL JUNCTION PITS, GULLIES AND SIDE ENTRY PITS SHALL BE LOCATED AS SHOWN ON THE DRAWINGS IRRESPECTIVE OF PIPE LENGTHS SHOWN ON THE DRAWINGS.
 - 3.5. CENTRELINES OF MANHOLES TO BE ALIGNED 3.0m FROM ROAD RESERVE BOUNDARY UNLESS OTHERWISE SHOWN.
 - 3.6. GROSS POLLUTANT TRAP SHALL BE SMARTSTREAM ECO-BITE OR SIMILAR APPROVED SUBSOIL RISER SHALL BE 100 DIA PVC WITH SCREW CAP FITTING WITHIN C COVER BOX/22x12x25x4 DEPTH. SPACING SHALL BE 50m APPROX.

WARNING
 BEWARE OF UNDERGROUND SERVICES.
 This drawing is for information only and does not guarantee the location, depth or condition of any underground services. It is the responsibility of the contractor to locate all underground services before commencing work. Refer to Worksafe Regulation 3.2.1.

DIAL 1100
 BEFORE YOU DIG

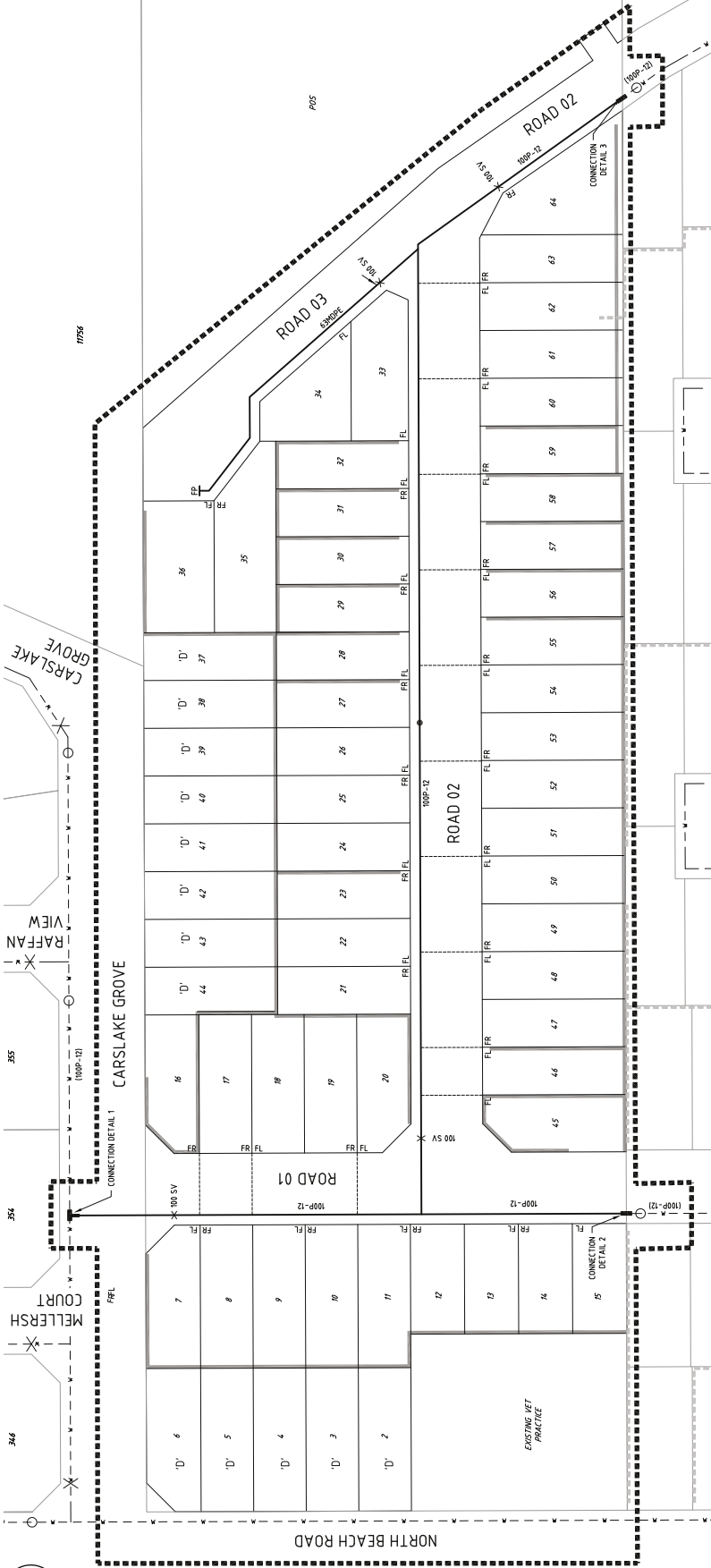
PRELIMINARY DRAWING
 NOT TO BE USED FOR CONSTRUCTION PURPOSES

ROADS AND DRAINAGE PLAN	
<p>CLIENT: DARRON BAYNHAM</p> <p>PROJECT: 455 (LOT 2) NORTH BEACH ROAD, GWELUP</p> <p>DRAWER: R. BARGERBUS</p> <p>DESIGN REVIEW: R. BARGERBUS</p> <p>REVISION: R. BARGERBUS</p>	<p>APPROVED PROJECT DIRECTOR: [Signature]</p> <p>REVISION REVIEW: R. BARGERBUS</p> <p>REVISION: R. BARGERBUS</p>
<p>SHEET: 01 OF 01</p> <p>DRAWING NO: SC00188.100</p> <p>DATE: 15/03/2017</p> <p>SCALE: 1:500</p> <p>REGION: B</p>	

<p>SPRING CONSULTING</p> <p>INNOVATIVE ENGINEERING SOLUTIONS</p>	
<p>Spring Consulting (Australia) Pty Ltd 10/111 North Beach Road, Suite 201, North Beach, WA 6020 Phone: (08) 9437 2222 Email: info@springconsulting.com.au</p>	

REV	DATE	AMENDMENT

REV	DATE	AMENDMENT



NOTES

- 10 GENERAL
- 11 THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DRAWINGS AND SPECIFICATION.
- 12 THE CONSTRUCTION OF THE WORKS SHALL COMPLY WITH THE WATER CORPORATION'S WATER SUPPLY RETICULATION MANUAL.
- 13 ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
- 14 THE MAINS SHALL BE LAID ON A 2.10m ALIGNMENT MEASURED FROM THE CENTRE OF THE PIPE TO THE ROAD RESERVE BOUNDARY UNLESS OTHERWISE NOTED.
- 15 THE MAINS SHALL BE LAID WITH A MINIMUM COVER OF 600mm.
- 16 ALL SERVICES TO LOTS SHALL BE FULLY PRELAD UNLESS NOTED OTHERWISE.
- 17 THE CONTRACTOR SHALL REPORT ANY DISCREPANCY OR CLASH WITH OTHER SERVICES TO THE SUPERINTENDENT.
- 18 REFER TO SERVICES PLANS FOR DETAILS OF EXISTING SERVICES.
- 19 THE CONTRACTOR SHALL ALLOWERS TO USE ANY SCREENED MATERIAL FOR BACKFILL AT ANY LEVEL IN THE TRENCH.
- 20 MAINS AND SERVICES
- 21 DEFERRED SERVICE
 - CONSTRUCT MAINS OF:
 - 63MDE - 77 m
 - 1000-12 - 373 m
- 22 CONSTRUCT SERVICES:
 - SHORT SINGLE 4
 - LONG SINGLE 4
 - LONG DUAL 2
 - DEFERRED SERVICE 11
- TOTAL LOTS SERVED 67

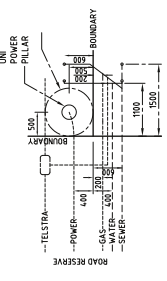
LEGEND

- 1000-12 EXISTING WATER MAIN LAYOUT, MAIN SIZE AND TYPE
- 1000-12 PROPOSED WATER MAIN LAYOUT, MAIN SIZE AND TYPE
- 1000-12 FUTURE WATER MAIN LAYOUT, MAIN SIZE AND TYPE
- SERVICE CROSSING COMPLETE
- 1000-12 PROPOSED SLUICE VALVE (1 OF)
- 1000-12 PROPOSED HYDRANT (1 OF)
- EXISTING VALVE
- EXISTING HYDRANT
- CHANGE IN PIPE SIZE
- FLUSHING POINT
- FP
- RETICULATION BOUNDARY
- CONDUIT SERVICE
- DEFERRED SERVICE
- EXISTING RETAINING WALL
- PROPOSED RETAINING WALL
- EXISTING TELSTRA
- EXISTING GAS
- EXISTING SEWER PRESSURE MAIN

PRELIMINARY DRAWING
NOT TO BE USED FOR CONSTRUCTION PURPOSES

THIS PLAN IS ACCEPTED AS COMPLYING WITH OVERALL SCHEME PLANNING.
COMPLIANCE WITH RELEVANT MANUALS REMAINS THE RESPONSIBILITY OF THE CONSULTING ENGINEER.
NO WORKS ARE TO COMMENCE ON SITE UNTIL STARTUP ARRANGEMENTS HAVE BEEN MADE WITH THE RELEVANT WORK INSPECTOR. SEE DEVELOPER'S MANUAL FOR CONTACT DETAILS.

XXXX-XXX-XXX



TYPICAL SERVICE POSITIONS DETAIL
SCALE DIAGRAMMATIC
(ALL DIMENSION IN mm)

FILE: -
SUB FILE: -

WATER RETICULATION

CLIENT	DARRON BAYNHAM
PROJECT	455 (LOT 2) NORTH BEACH ROAD, GWELUP
DRAWER	R. BARBERIS
DESIGNED BY	R. BARBERIS
CHECKED BY	R. BARBERIS
APPROVED BY	R. BARBERIS
DATE	15/03/2017
SCALE	1:500
SHEET NO.	A1
TOTAL SHEETS	1
PROJECT NO.	SC00188.100
DRAWING NO.	C4.00
REGION	B

SERLING CONSULTING
INNOVATIVE ENGINEERING SOLUTIONS

Serling Consulting (Australia) Pty Ltd
100/100 North Beach Road, Gwelup, WA 6154
Phone: (08) 9438 8000
Fax: (08) 9438 8001
Email: info@serling.com.au
www.serling.com.au

APPROVED BY: R. BARBERIS
DATE: 15/03/2017

NO.	REV	DATE	CHECK	BY	AMENDMENT

NO.	REV	DATE	CHECK	BY	AMENDMENT

NO.	REV	DATE	CHECK	BY	AMENDMENT

F:\projects\SC00188\DWG\DWG\SC00188-100-C400 Richard Burgess 15/03/2017 1:20:55 PM

Serling Consulting (Australia) Pty Ltd
Contract No: SC00181.100
455 (Lot 2) North Beach Road, Gwelup

Appendix C Dial Before You Dig (DBYD) Data



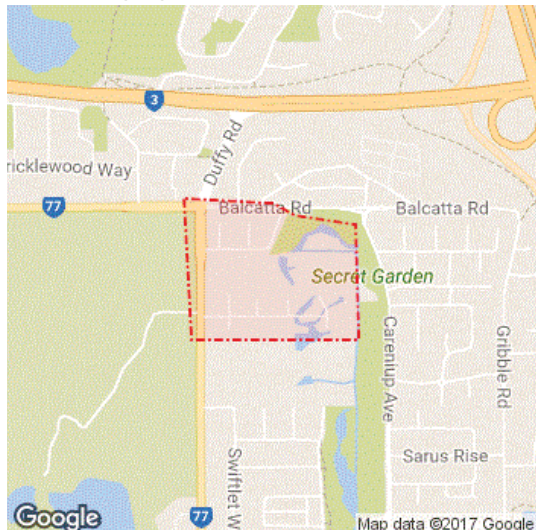
Caller Details

Contact: Mr Calvin Kirk
Company: Serling Consulting
Address: Unti 1 61 Gutherie Street
Osborne Park WA 6017

Caller Id: 1235457
Mobile: 0406450611
Email: ckirk@serling.com.au
Phone: 0865008888
Fax: Not Supplied

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.



User Reference: 455 Nth Beach Rd
Working on Behalf of: Private
Enquiry Date: 13/03/2017
Start Date: 17/03/2017
End Date: 17/03/2017

Address: Lot 455 Beach Road
North Beach WA 6020
Job Purpose: Excavation
Onsite Activity: Manual Excavation
Location of Workplace: Both
Location in Road: CarriageWay, Footpath, Nature Strip

- Check that the location of the dig site is correct. If not you must submit a new enquiry.
- Should the scope of works change, or plan validity dates expire, you must submit a new enquiry.
- Do NOT dig without plans. Safe excavation is your responsibility. If you do not understand the plans or how to proceed safely, please contact the relevant asset owners.

Notes/Description of Works:
Not Supplied

Your Responsibilities and Duty of Care

- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at www.1100.com.au
- For more information on safe excavation practices, visit www.1100.com.au

Asset Owner Details

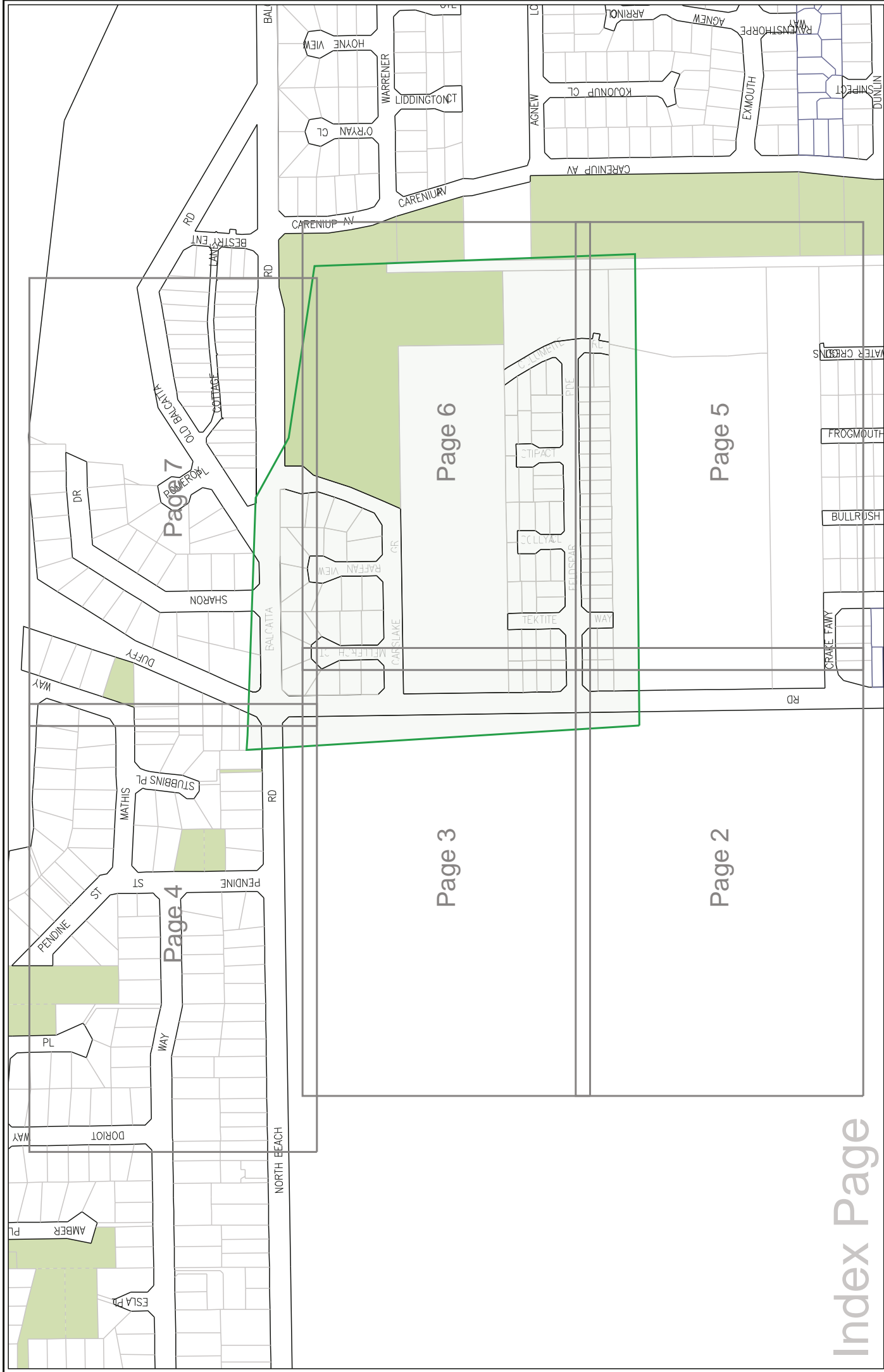
The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, so it is **your responsibility** to identify and contact any asset owners not listed here directly.

** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.

Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

Seq. No.	Authority Name	Phone	Status
59586728	ATCO Gas Australia	131352	NOTIFIED
59586731	NBN Co, Wa	1800626762	NOTIFIED
59586726	Telstra, WA	1800653935	NOTIFIED
59586729	Water Corporation WA	0894248115	NOTIFIED
59586724	Western Power	1300769345	NOTIFIED

END OF UTILITIES LIST



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Scale: 1:4567

Sequence No: 59586729

Print Date: 13/03/2017 Page: 1 of 7



WARNING - CRITICAL PIPELINE
 Refer to Information Brochure Damage Prevention and Legend for details

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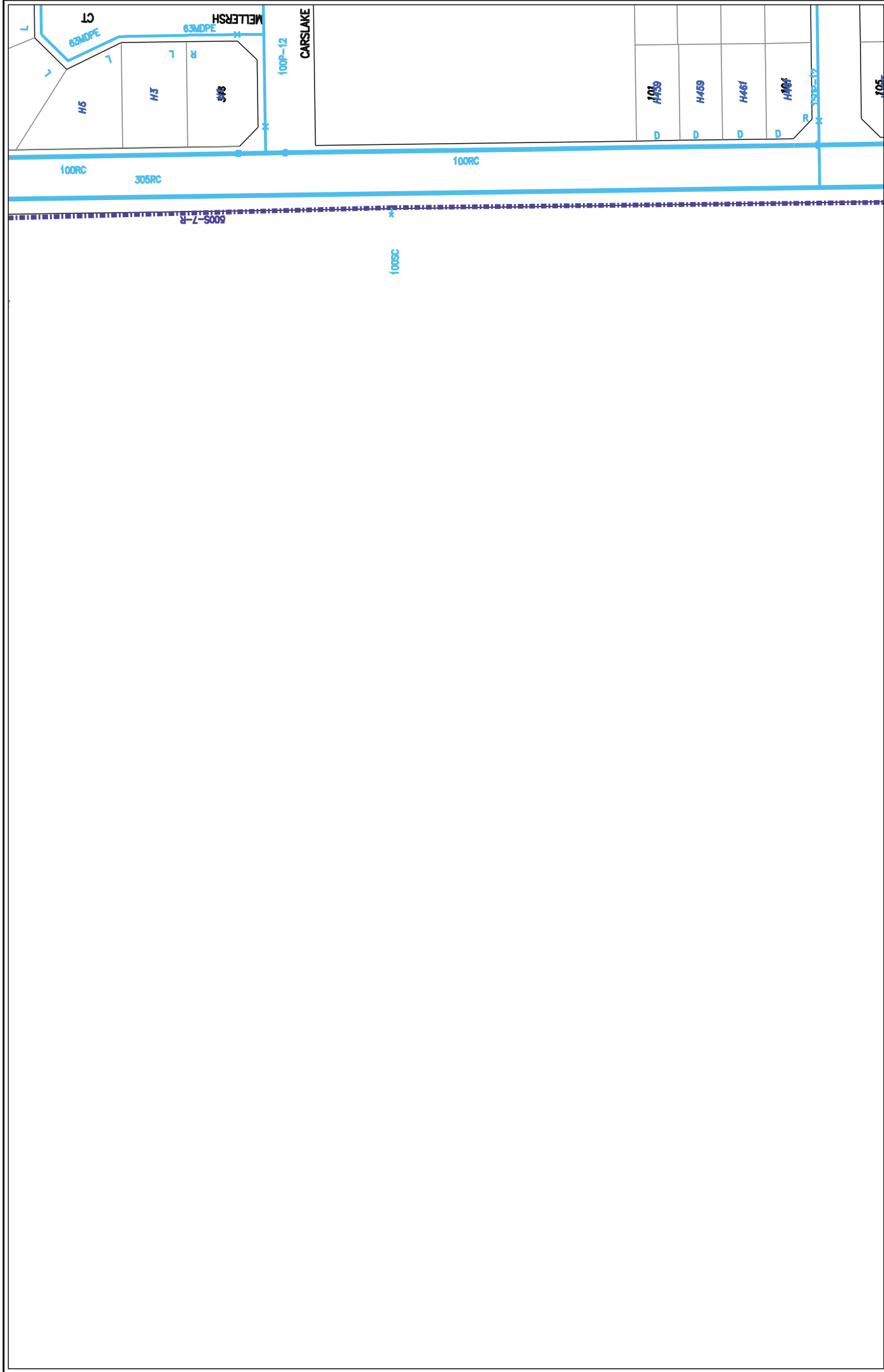


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WARNING - CRITICAL PIPELINE
 Refer to **Information Brochure Damage Prevention** and **Legend** for details

Scale: 1:1500 Centre Point: 115.789°, -31.863°
 Sequence No: 59586729
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Water

Scale: 1:1500 Centre Point: 115.789°, -31.861°

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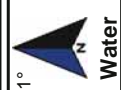
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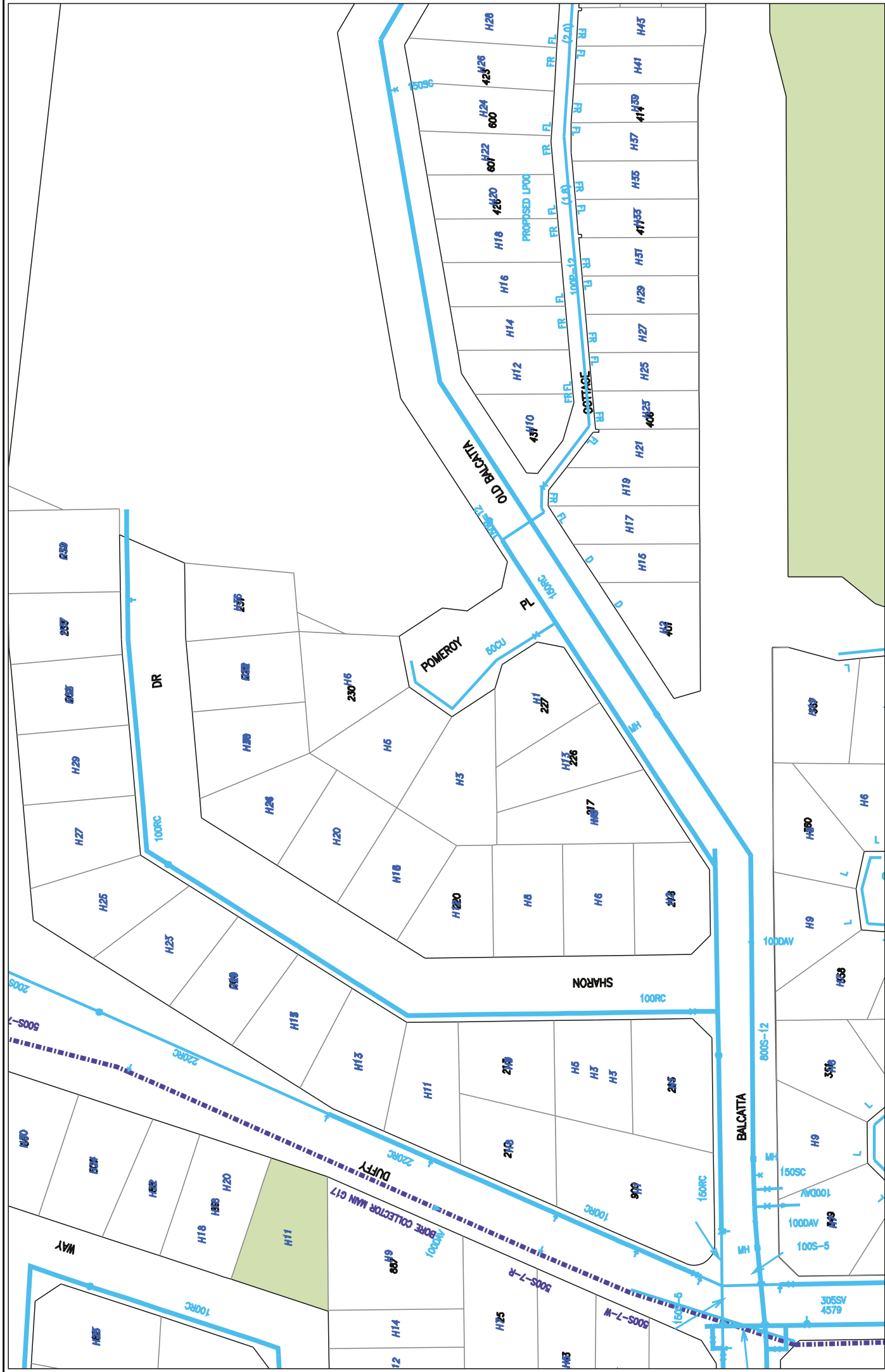
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Water

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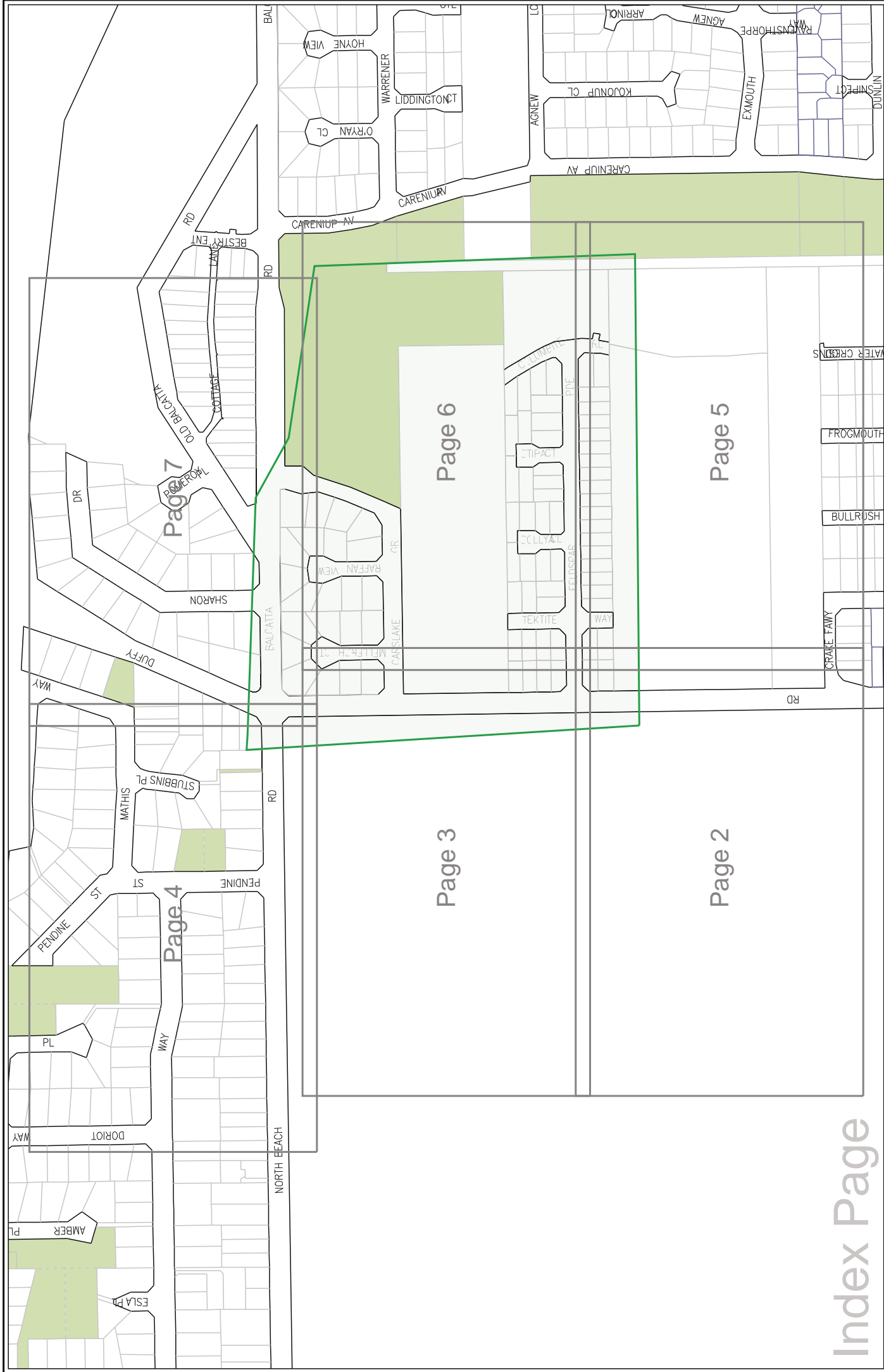
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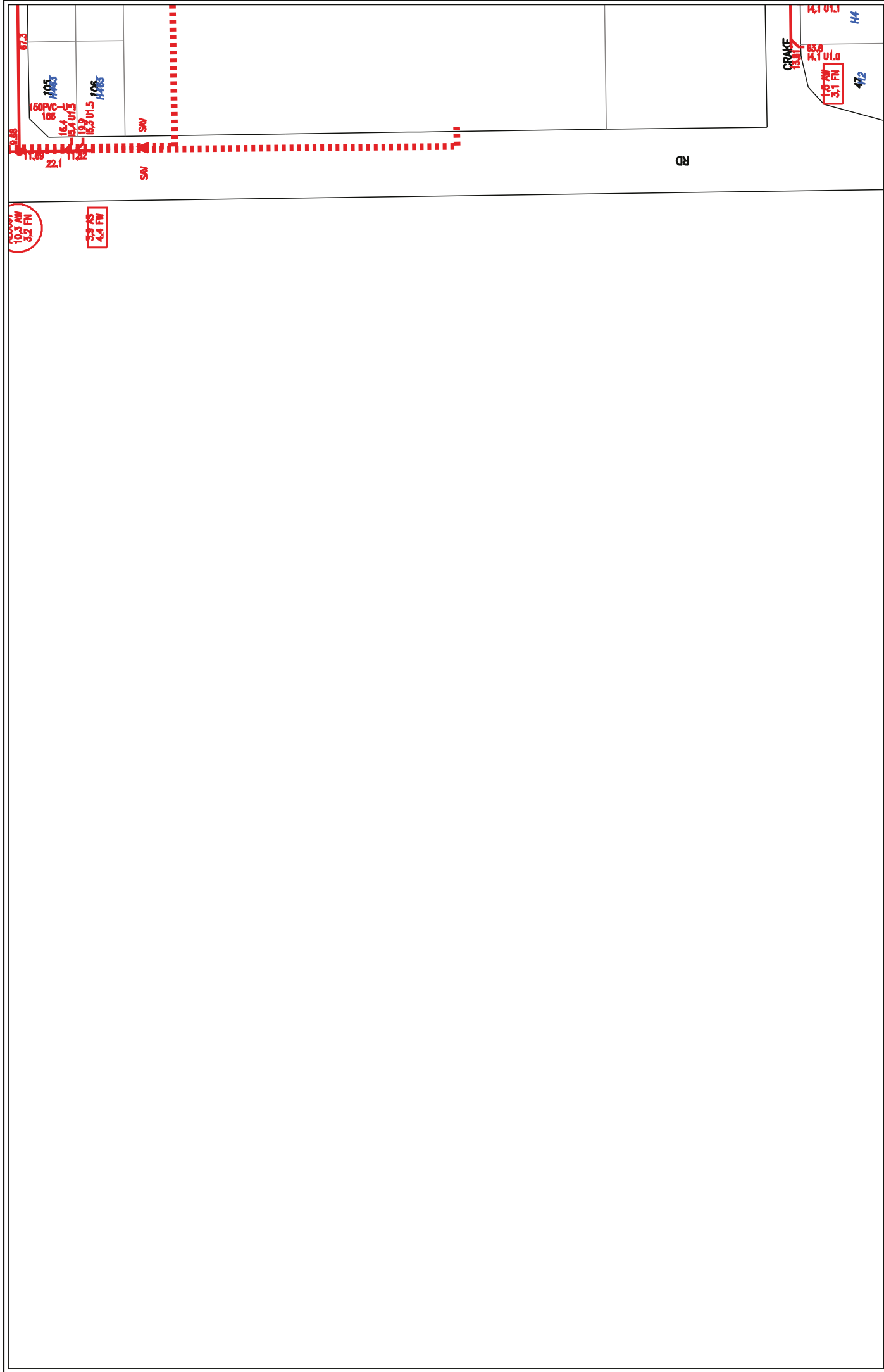
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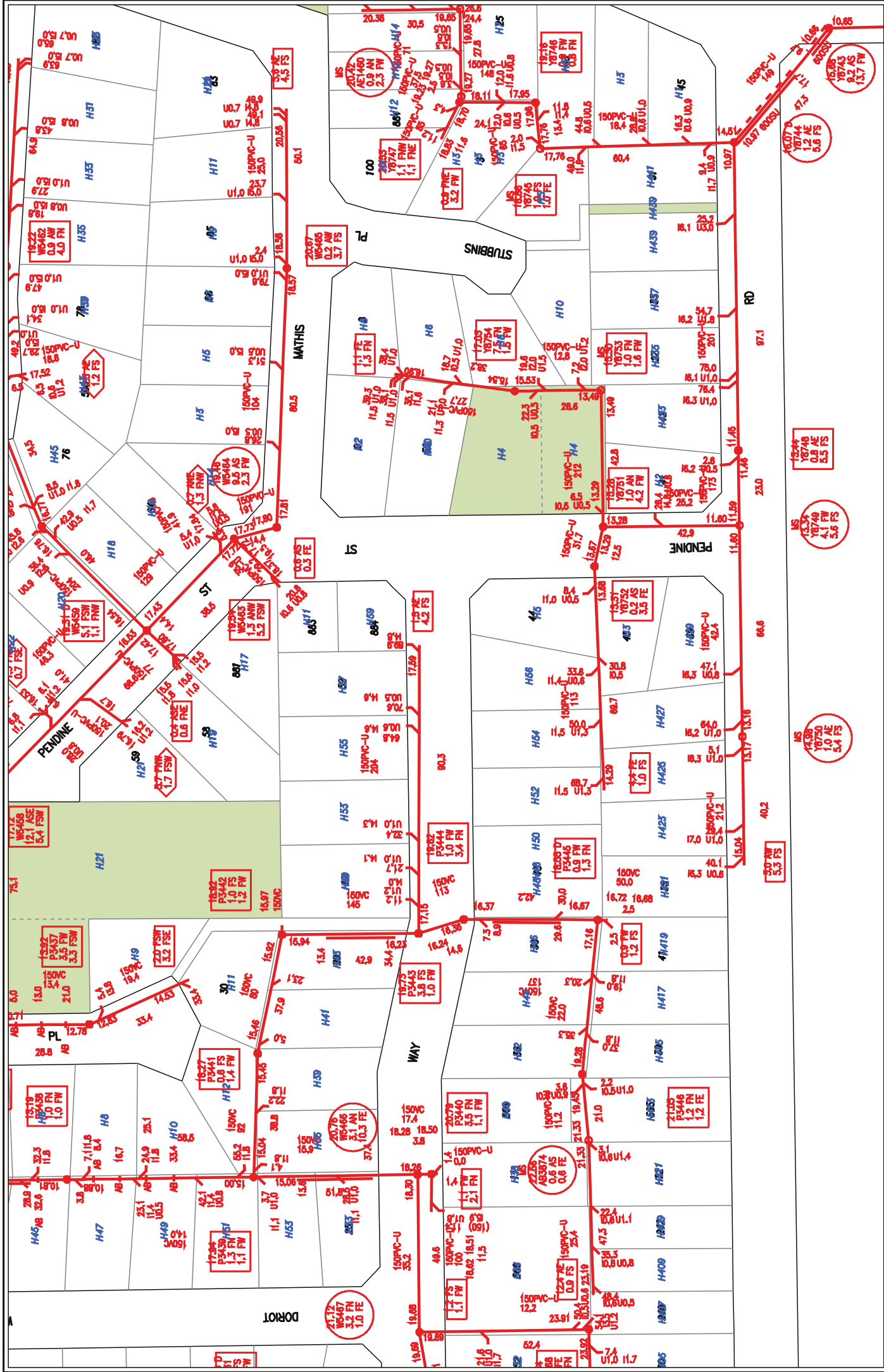


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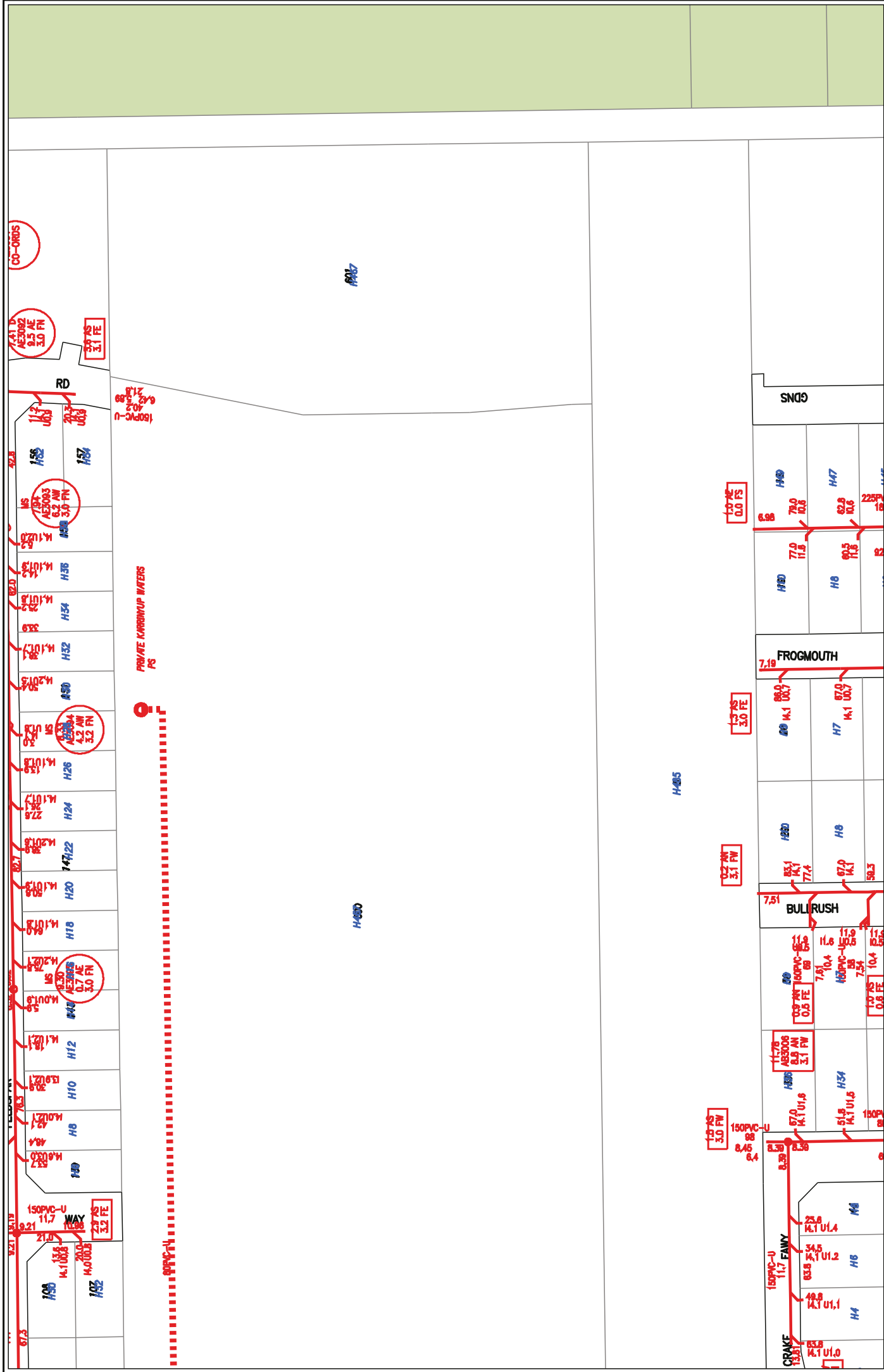
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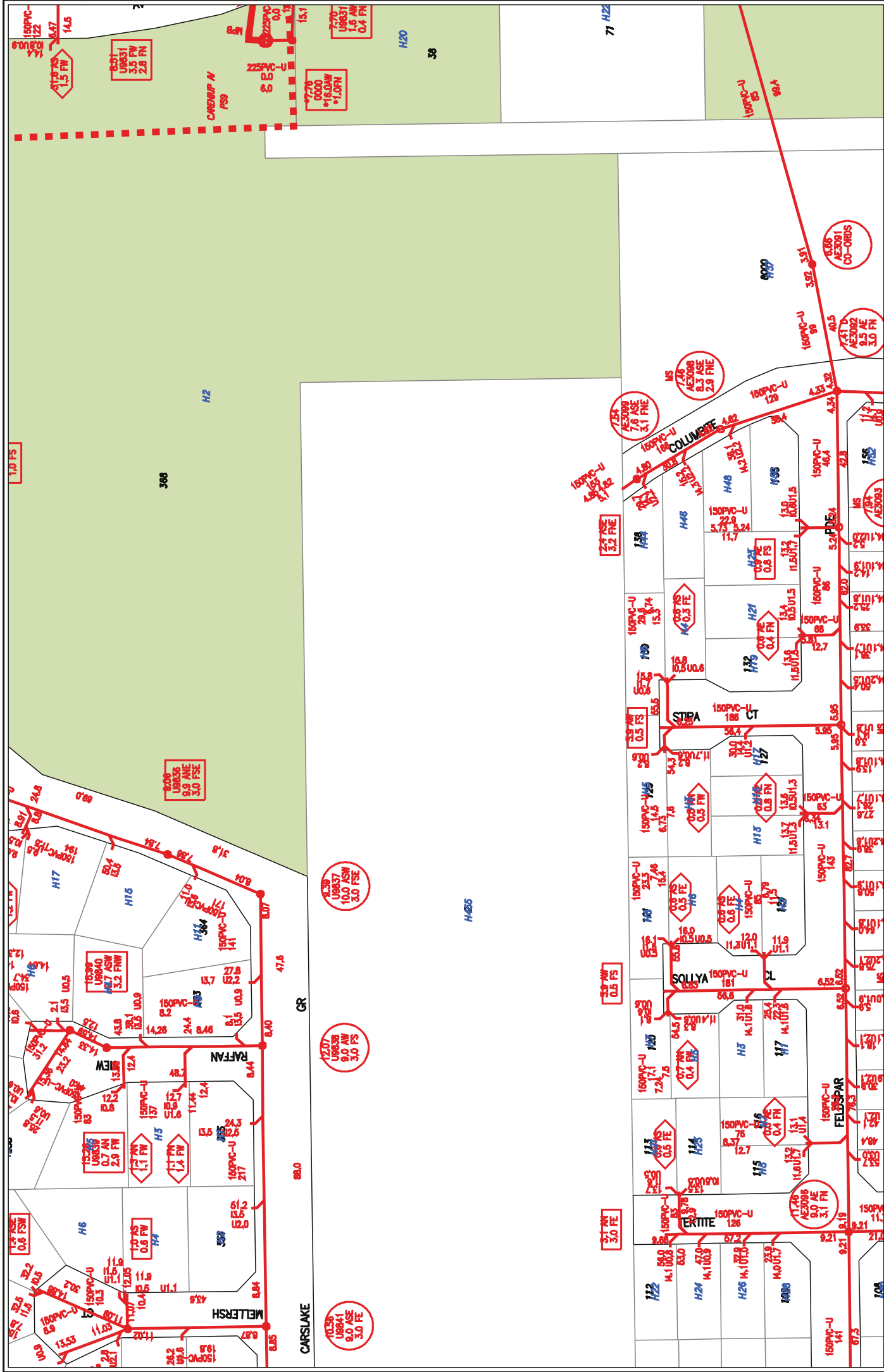




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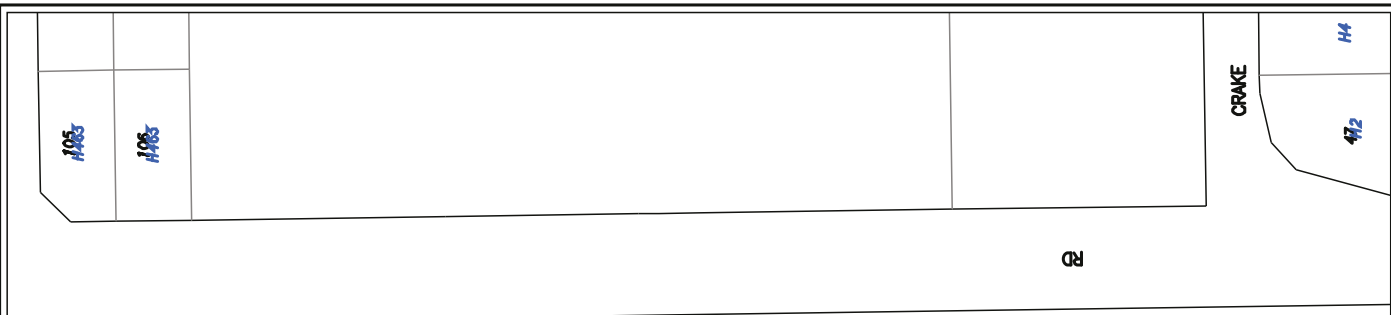
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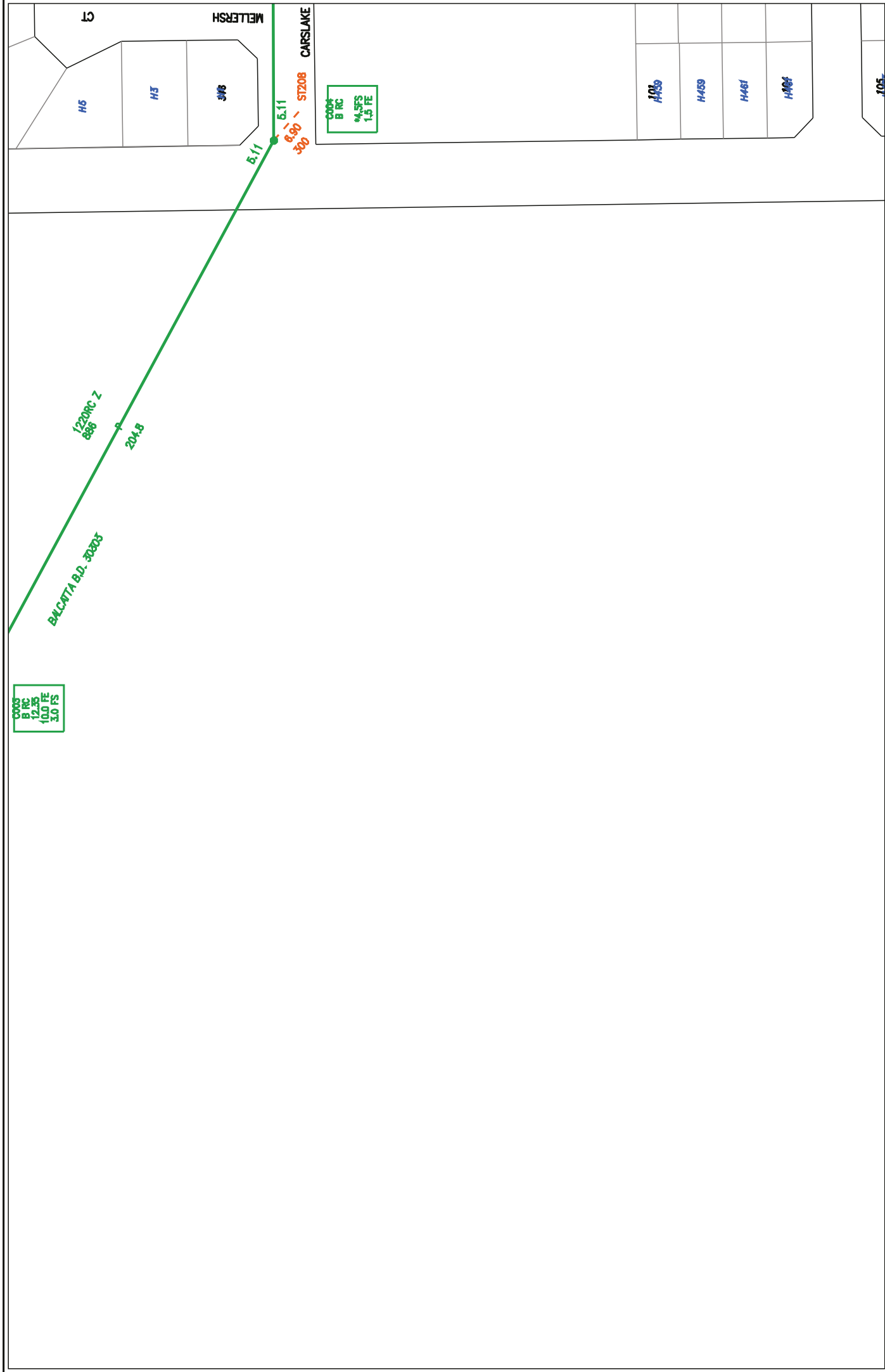
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CRAKE

H4

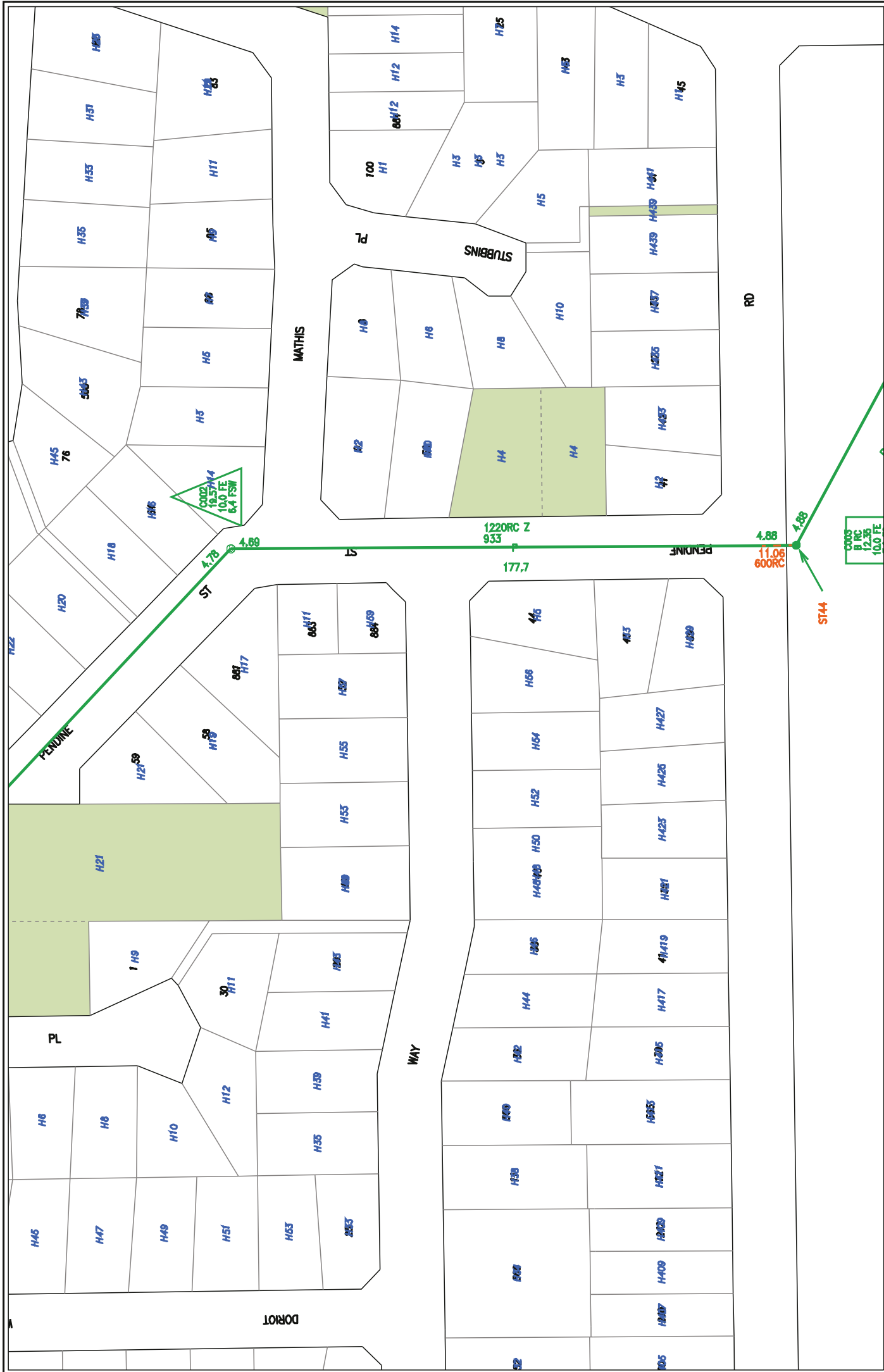
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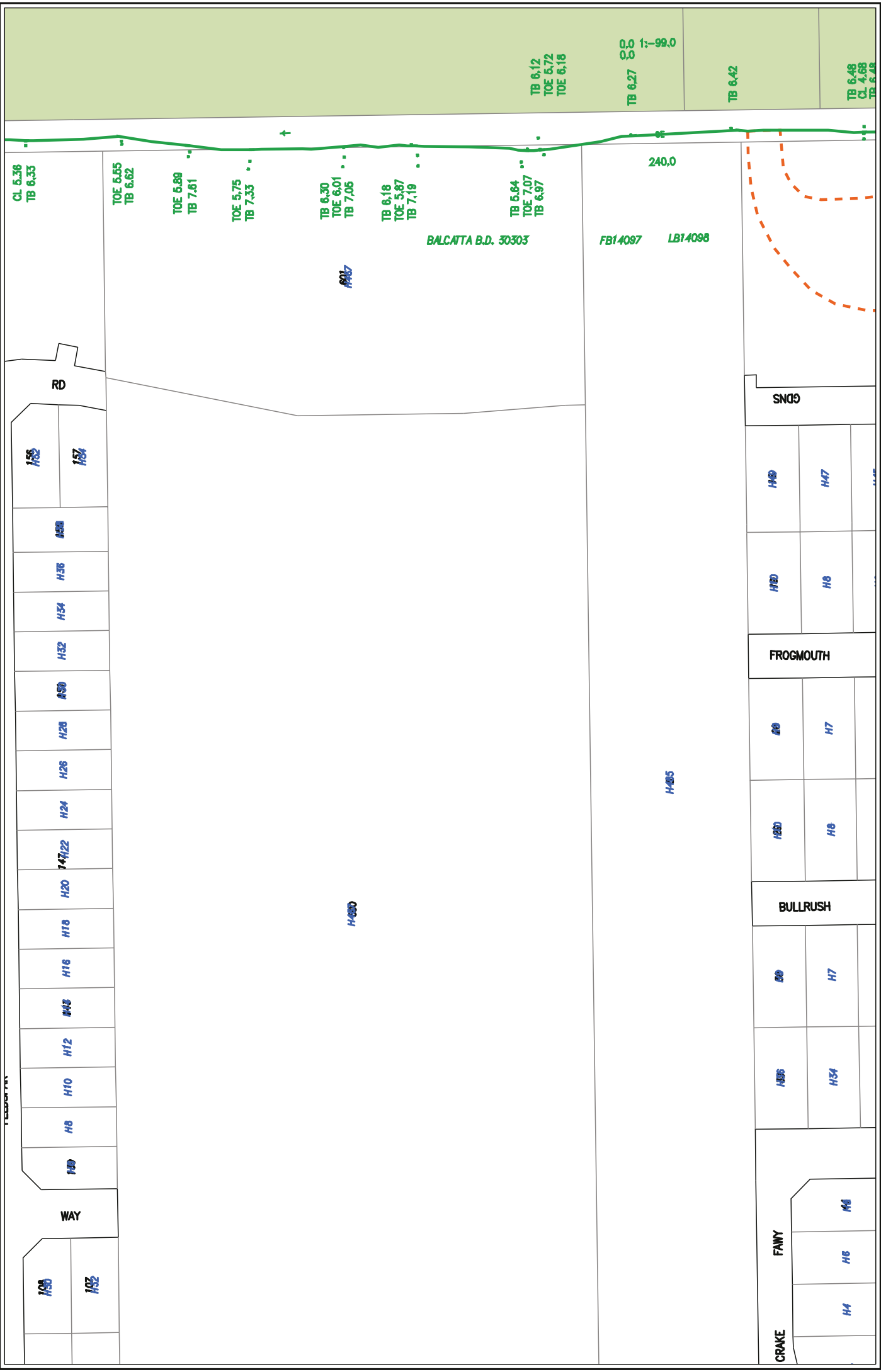


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Drainage





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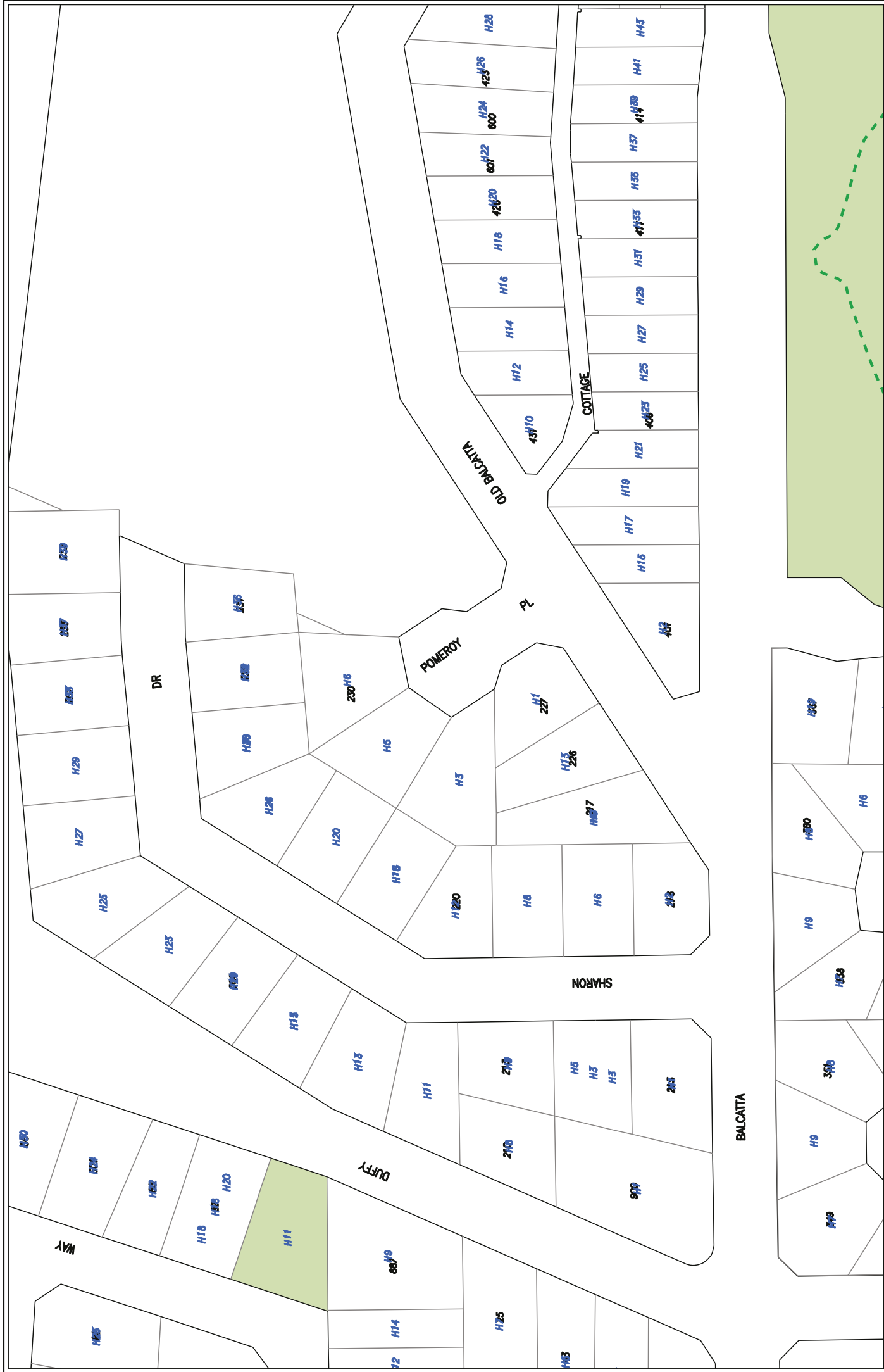


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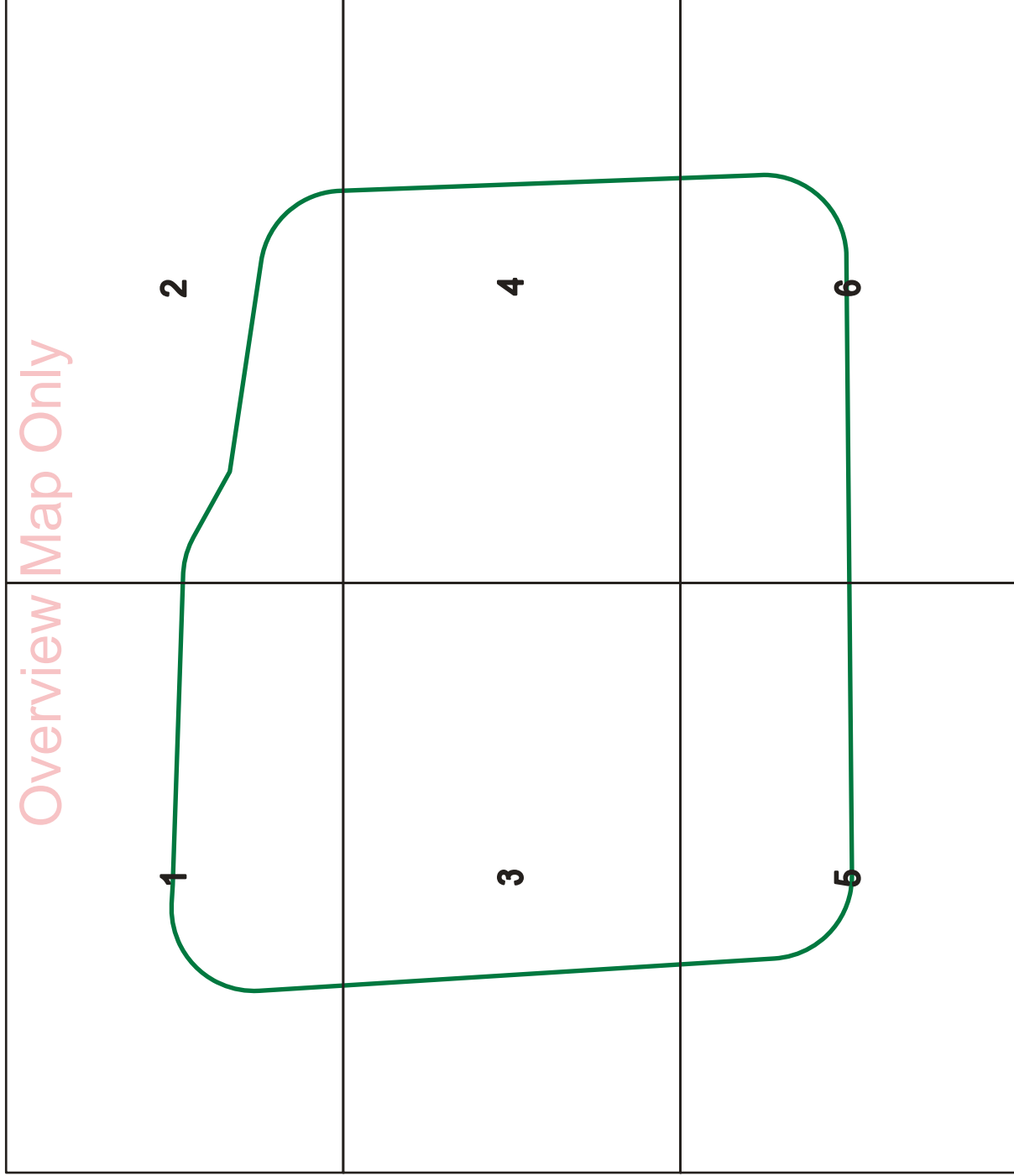
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WARNING - HIGH PRESSURE PIPELINE IN THE VICINITY.

No works within 15 metres of this asset are permitted without prior approval from ATCO Gas Australia PH 1300 926 755



OVERVIEW ONLY



UNDERGROUND LEGEND

Structures	
P	Pillar
□	UG Crossing *
■	Metal Pole
■	Ring Main Unit
#	Transformer
#	LV Distribution
#	Site Frame

Distribution Cables	
—	High Voltage Cable (1kV - 33kV)
—	Low Voltage Cable (< 1kV)
—	Street Light Circuit (< 1kV)
—	Street Light Pilot (< 1kV)
—	Earth Wire

Cable Pole Terminations	
○	HV Termination
#	LV Termination

Proposed Construction Assets	
■	Design Area *
—	High Voltage Underground Cable
—	Low Voltage Underground Cable
○	Metal Pole
○	Pillar
○	Transformer site

State Underground Power Project

■	CURRENT Work Area *
■	COMPLETED Area *

Feature	
□	Area of Interest

* Please refer to coversheet

Privately owned cables NOT SHOWN
(including house services)

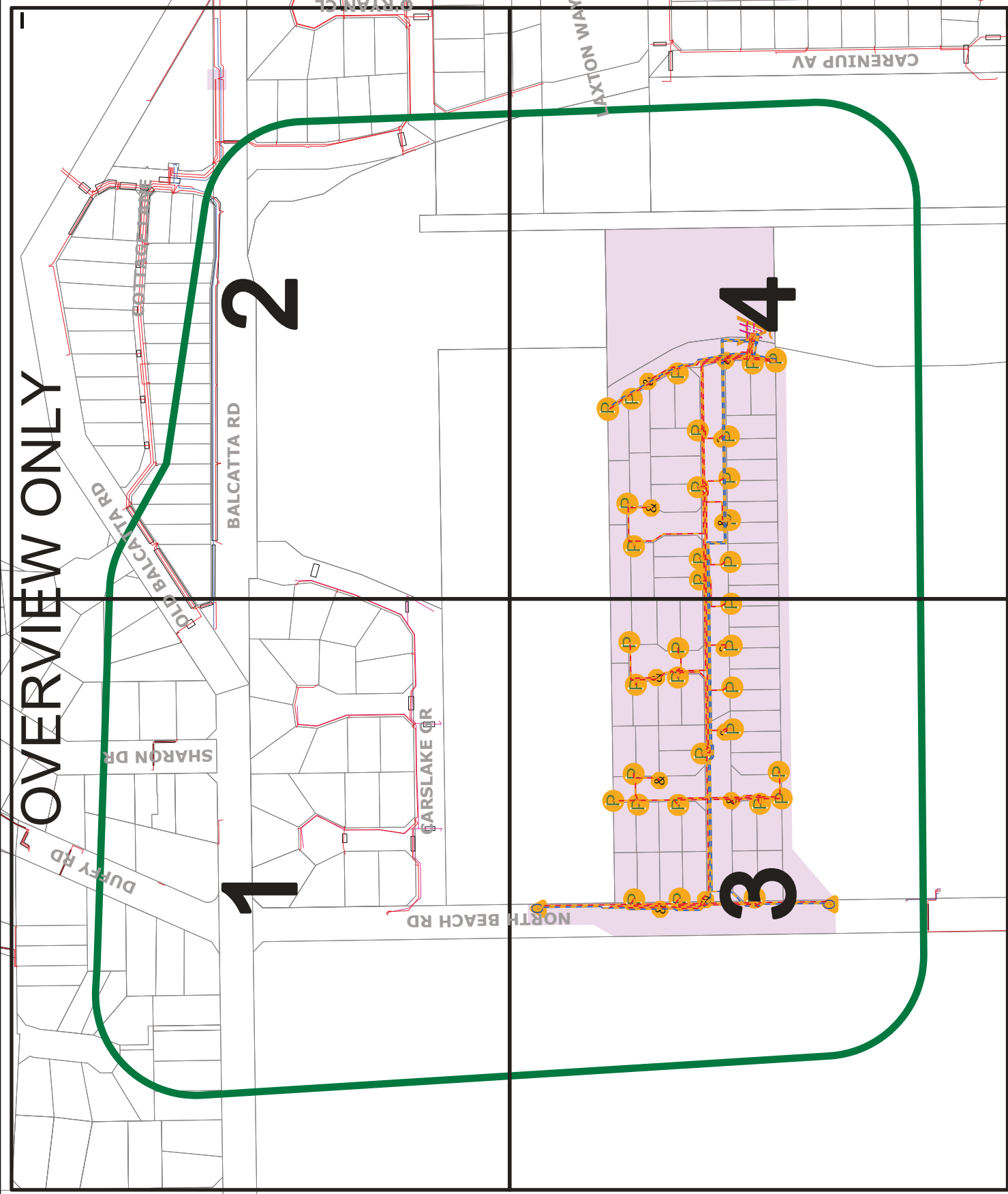
This map is INDICATIVE ONLY.
Hand exposure via pothole
method is MANDATORY.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days
from date of issue

A4 Scale : 1:3075

**WARNING! Look out for
overhead power lines**





UNDERGROUND LEGEND

- Structures**
- P Pillar
 - UG Crossing *
 - Ring Main Unit
 - Transformer
 - LV Distribution
 - Site Frame
- Distribution Cables**
- High Voltage Cable (1kV - 33kV)
 - Low Voltage Cable (< 1kV)
 - Street Light Circuit (< 1kV)
 - Street Light Pilot (< 1kV)
 - Earth Wire
- Cable Pole Terminations**
- HV Termination
 - LV Termination
 - # LV Termination
- Proposed Construction Assets**
- Design Area *
 - High Voltage Underground Cable
 - Low Voltage Underground Cable
 - Metal Pole
 - HV Termination
 - Pillar
 - Transformer site

- State Underground Power Project**
- CURRENT Work Area *
 - COMPLETED Area *
- Feature**
- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

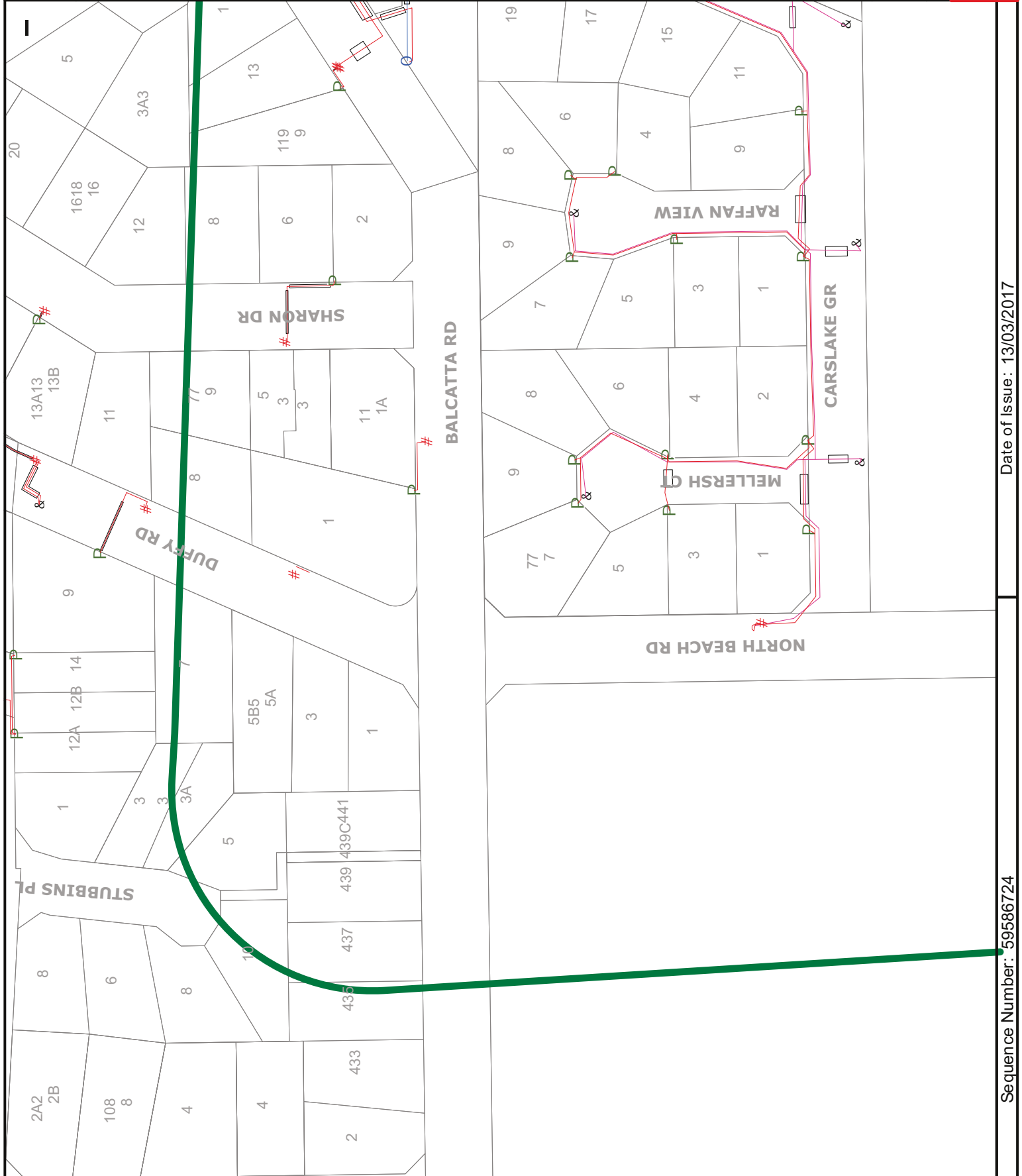
This map is INDICATIVE ONLY.
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Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 Scale : 1:1500

WARNING! Look out for overhead power lines



UNDERGROUND LEGEND

- Structures**
- P Pillar
 - & Metal Pole
 - # Transformer Site
 - UG Crossing *
 - Ring Main Unit
 - LV Distribution Frame
- Distribution Cables**
- High Voltage Cable (1kV - 33kV)
 - Low Voltage Cable (< 1kV)
 - Street Light Circuit (< 1kV)
 - Street Light Pilot (< 1kV)
 - Earth Wire
- Cable Pole Terminations**
- O HV Termination
 - # LV Termination
- Proposed Construction Assets**
- Design Area *
 - High Voltage Underground Cable
 - Low Voltage Underground Cable
 - Metal Pole
 - Pillar
 - Transformer site

State Underground Power Project

- CURRENT Work Area *
 - COMPLETED Area *
- Feature**
- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

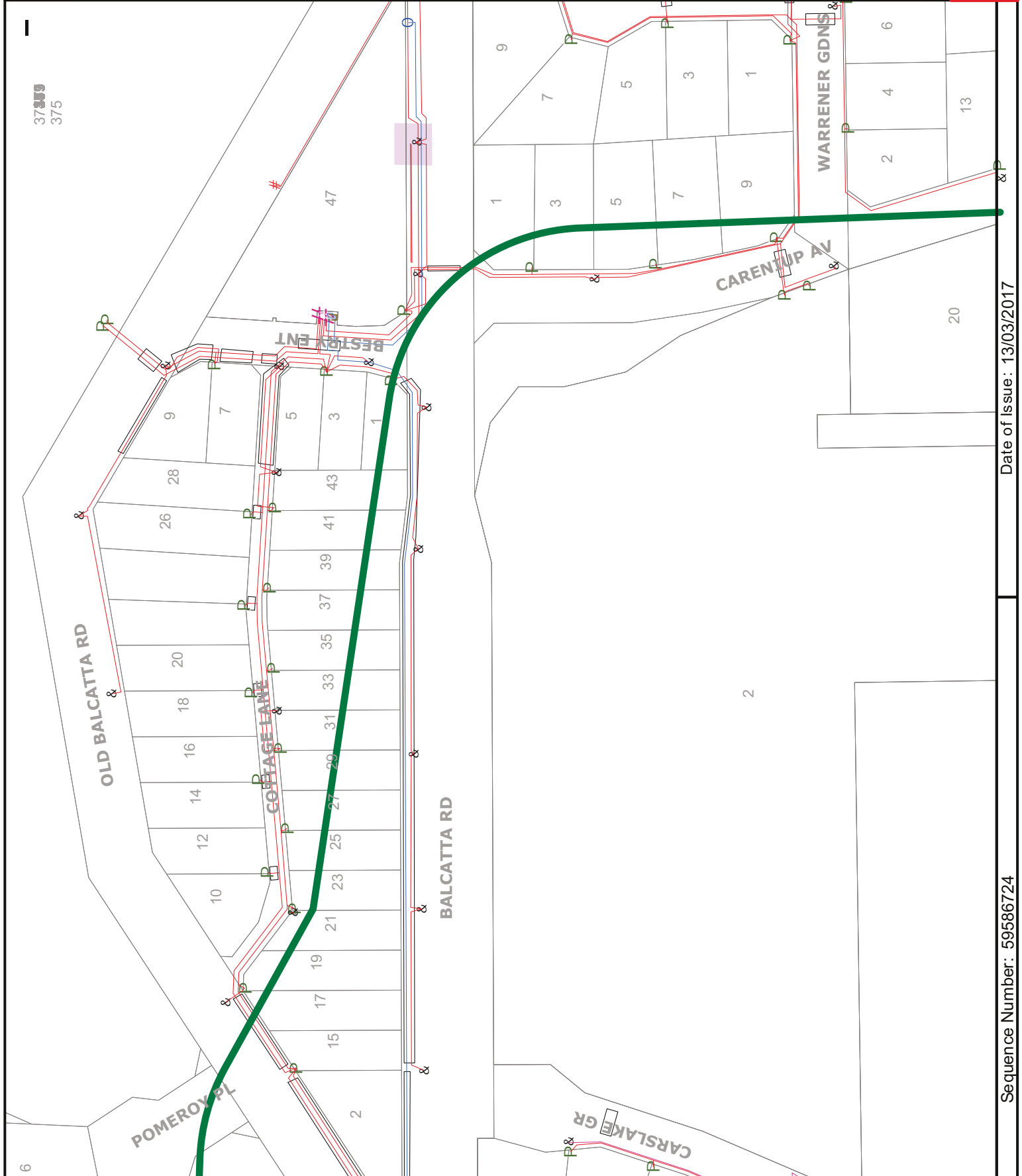
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Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 Scale : 1:1500

WARNING! Look out for overhead power lines



UNDERGROUND LEGEND

- Structures**
- P Pillar
 - & Metal Pole
 - # Transformer
 - UG Crossing *
 - ▨ Ring Main Unit
 - ▨ LV Distribution Frame
- Distribution Cables**
- High Voltage Cable (1kV - 33kV)
 - Low Voltage Cable (< 1kV)
 - Street Light Circuit (< 1kV)
 - Street Light Pilot (< 1kV)
 - Earth Wire
- Cable Pole Terminations**
- HV Termination
 - # LV Termination
- Proposed Construction Assets**
- Design-Area ***
- High Voltage Underground Cable
 - Low Voltage Underground Cable
 - Metal Pole
 - HV Termination
 - LV Termination
 - Pillar
 - Transformer site

- State Underground Power Project**
- ▨ CURRENT Work Area *
 - ▨ COMPLETED Area *
- Feature**
- ▭ Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN
(including house services)

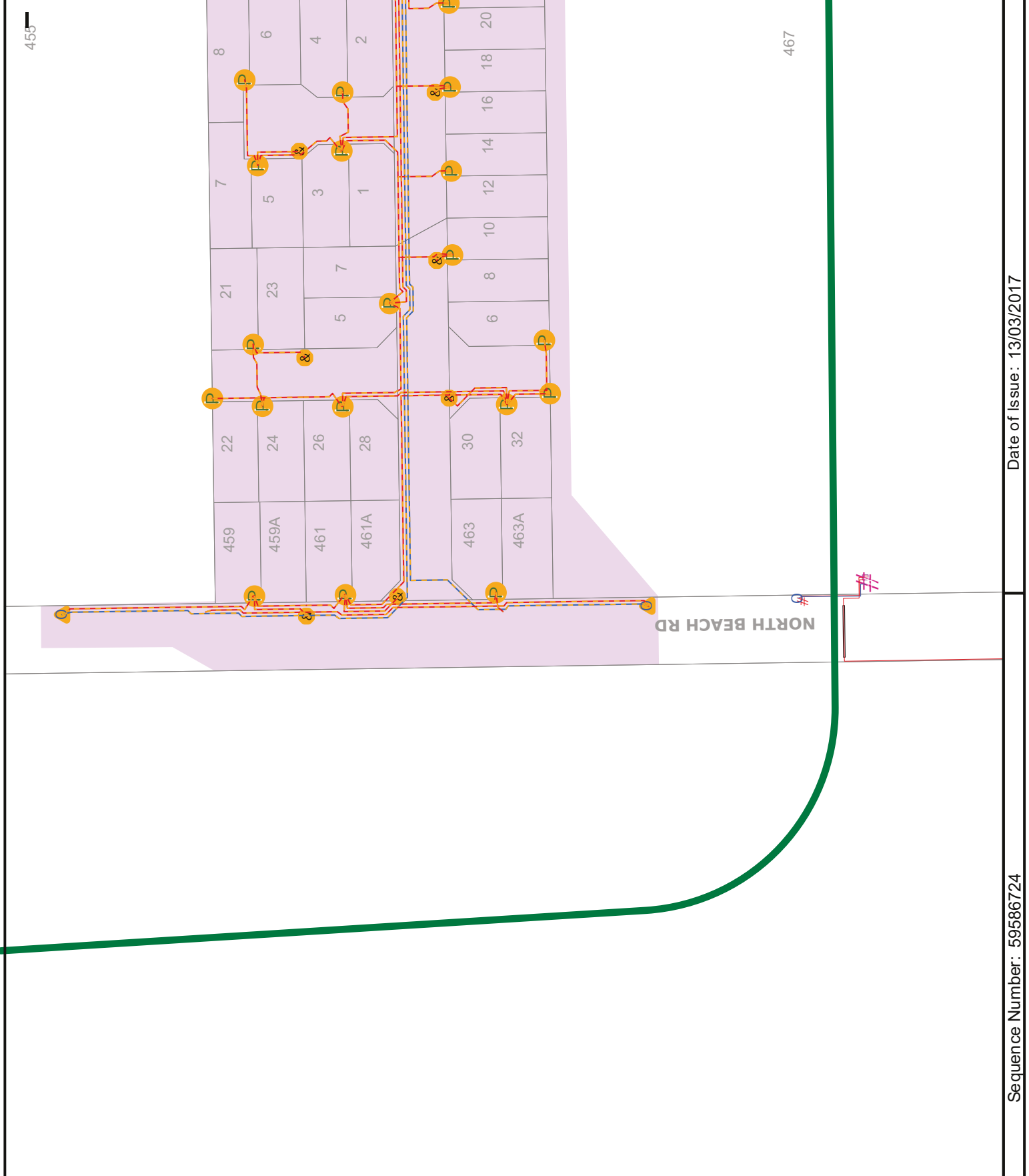
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Telephone Support: 1300 769 345
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Information valid for 30 days
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A4 Scale : 1:1500

WARNING! Look out for overhead power lines



UNDERGROUND LEGEND

- Structures**
- P Pillar
 - & Metal Pole
 - # Transformer Site
 - UG Crossing *
 - Ring Main Unit
 - LV Distribution Frame
- Distribution Cables**
- High Voltage Cable (1kV - 33kV)
 - Low Voltage Cable (< 1kV)
 - Street Light Circuit (< 1kV)
 - Street Light Pilot (< 1kV)
 - Earth Wire

- Cable Pole Terminations**
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 - Pillar
 - Transformer site

- State Underground Power Project**
- CURRENT Work Area *
 - COMPLETED Area *
- Feature**
- Area of Interest

*** Please refer to coversheet**

Privately owned cables NOT SHOWN (including house services)

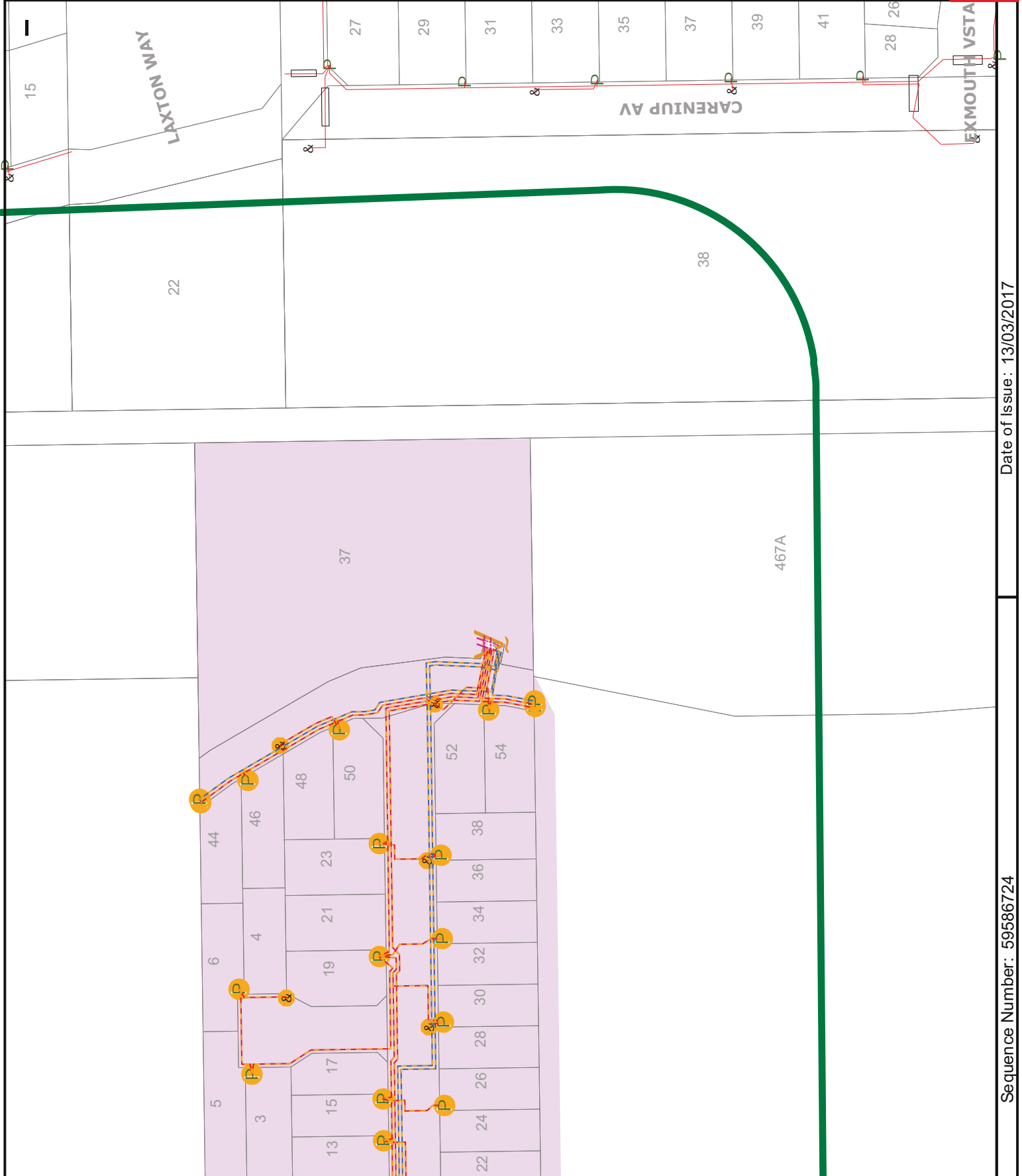
This map is INDICATIVE ONLY.
Hand exposure via pothole method is MANDATORY.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

PA4 Scale : 1:1500

WARNING! Look out for overhead power lines



OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

Low Voltage (< 1kV)

Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

*** Please refer to coversheet
Privately owned cables NOT SHOWN
(including house services)**

This map is **INDICATIVE ONLY**.

Check that you have enough clearance from the **DANGER ZONES** near overhead powerlines.

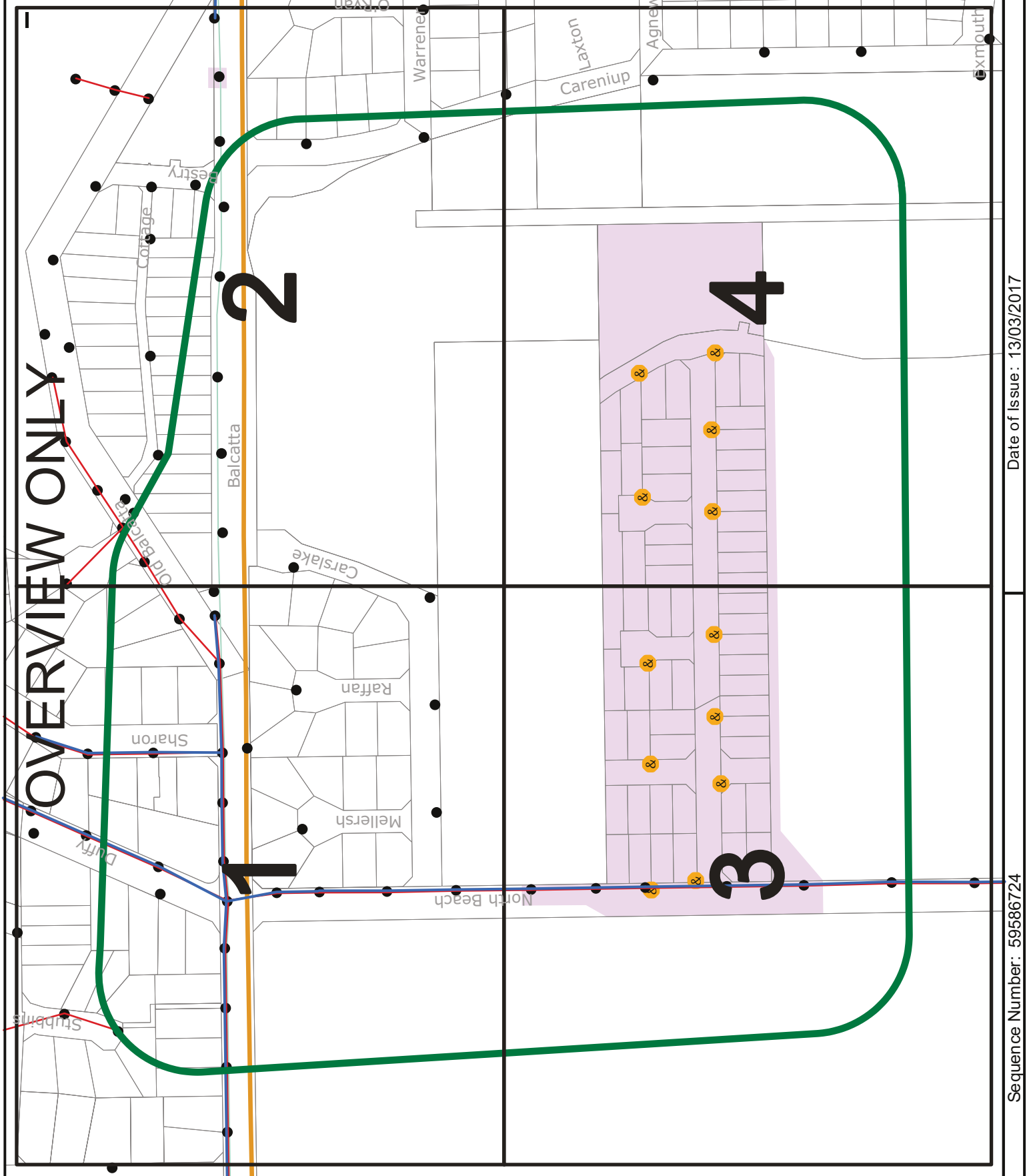
Telephone Support: 1300 769 345

Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 Scale : 1:3075

WARNING! Look out for overhead power lines



OVERVIEW ONLY



OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

Low Voltage (< 1kV)

Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest



*** Please refer to coversheet
Privately owned cables NOT SHOWN
(including house services)**

This map is INDICATIVE ONLY.
Check that you have enough
clearance from the DANGER ZONES
near overhead powerlines.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days
from date of issue

A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**

OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

Low Voltage (< 1kV)

Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

*** Please refer to coversheet**
Privately owned cables NOT SHOWN
(including house services)

This map is **INDICATIVE ONLY**.

Check that you have enough clearance from the **DANGER ZONES** near overhead powerlines.

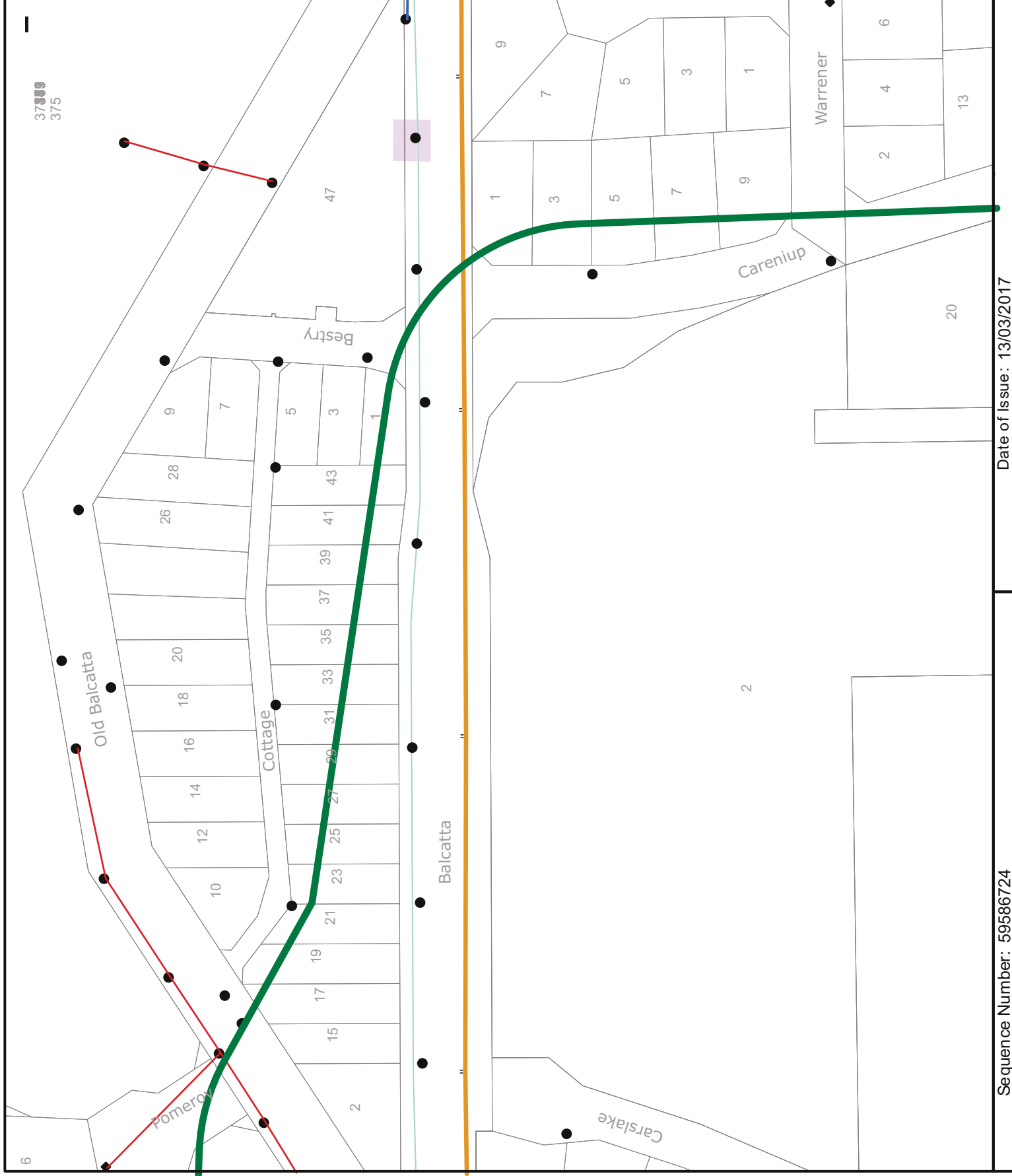
Telephone Support: 1 300 769 345

Mon to Fri - 08:00 to 16:30

Information valid for 30 days from date of issue

A4 Scale : 1:1500

WARNING! Look out for overhead power lines



OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

Transmission (33kV - 330kV)

Distribution Overhead Powerline

High Voltage (1kV - 33kV)

Low Voltage (< 1kV)

Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

455

467

North Beach

*** Please refer to coversheet**
Privately owned cables NOT SHOWN
(including house services)

This map is **INDICATIVE ONLY**.
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 clearance from the **DANGER ZONES**
 near overhead powerlines.

Telephone Support: 1 300 769 345
 Mon to Fri - 08:00 to 16:30

Information valid for 30 days
 from date of issue

A4 Scale : 1:1500

**WARNING! Look out for
 overhead power lines**



OVERHEAD LEGEND

Structures

& Power Pole " Transmission Poles

Transmission Overhead Powerline

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Distribution Overhead Powerline

High Voltage (1kV - 33kV)

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Proposed Construction Assets

Design Area *

High Voltage Overhead Powerline

Low Voltage Overhead Powerline

& Power Pole

Communications Assets

Overhead Pilot Cable

Feature

Area of Interest

*** Please refer to coversheet**
Privately owned cables NOT SHOWN
(including house services)

This map is **INDICATIVE ONLY**.
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near overhead powerlines.

Telephone Support: 1300 769 345
Mon to Fri - 08:00 to 16:30

Information valid for 30 days
from date of issue


A4 Scale : 1:1500

**WARNING! Look out for
overhead power lines**








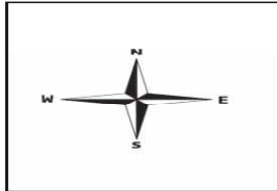


Indicative Plans

Issue Date:	13/03/2017	 DIAL BEFORE YOU DIG www.1100.com.au
Location:	Lot 455 Beach Road, North Beach, WA-6020	

1	4
2	5
3	6

	LEGEND	
	<p>Type: Telco Technology: Fibre</p> <p>Assets</p> <p> IN-SERVICE/ Cable/ Duct/ Trench</p> <p> DESIGNED/CONSTRUCTED/ Cable/ Duct/ Trench</p>	<p> Pit/Manhole</p> <p>Scale 0 20 40 60 Meters  1:2000 1 cm equals 20 m</p>



LEGEND

Type: Telco
Technology: Fibre

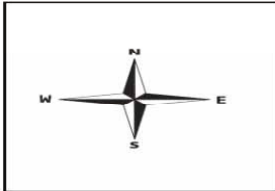
Assets

- IN-SERVICE: Cable/ Duct/ Trench
- DESIGNED/CONSTRUCTED: Cable/ Duct/ Trench
- Pit/Manhole

Scale

0 20 40 60 Meters

1:2000
1 cm equals 20 m



LEGEND

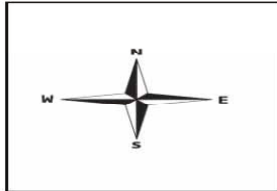
Type: Telco
Technology: Fibre

Assets

- IN-SERVICE: Cable/ Duct/ Trench (Green line)
- DESIGNED/CONSTRUCTED: Cable/ Duct/ Trench (Blue line)
- Pit/Menhole (Orange square)

Scale

0 20 40 60 Meters
1:2000
1 cm equals 20 m



Type: Telco
Technology: Fibre
Assets

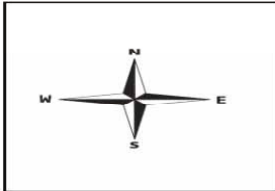
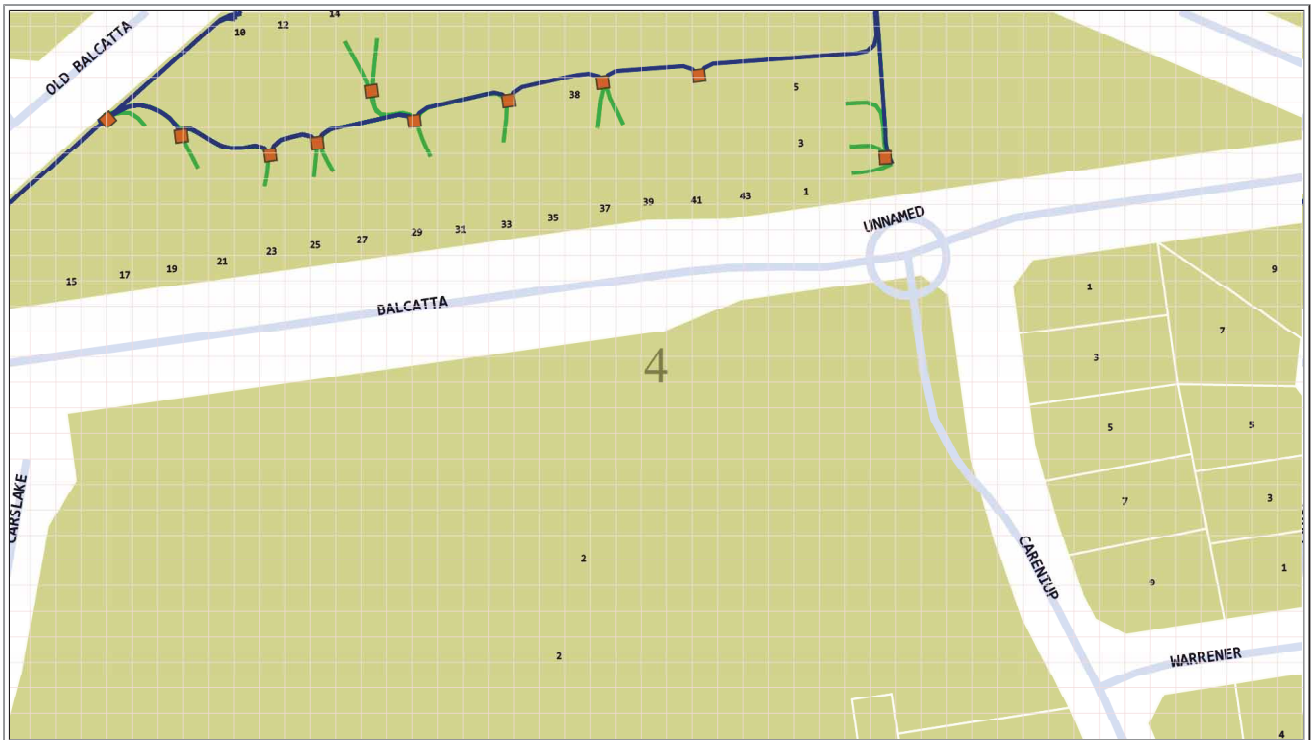
- IN-SERVICE:
Cable/ Duct/ Trench
- DESIGNED/CONSTRUCTED:
Cable/ Duct/ Trench

Pit/Menhole

LEGEND

Scale

0 20 40 60 Meters
1:2000
1 cm equals 20 m

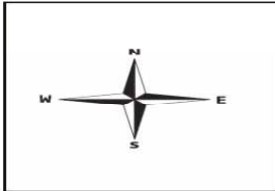
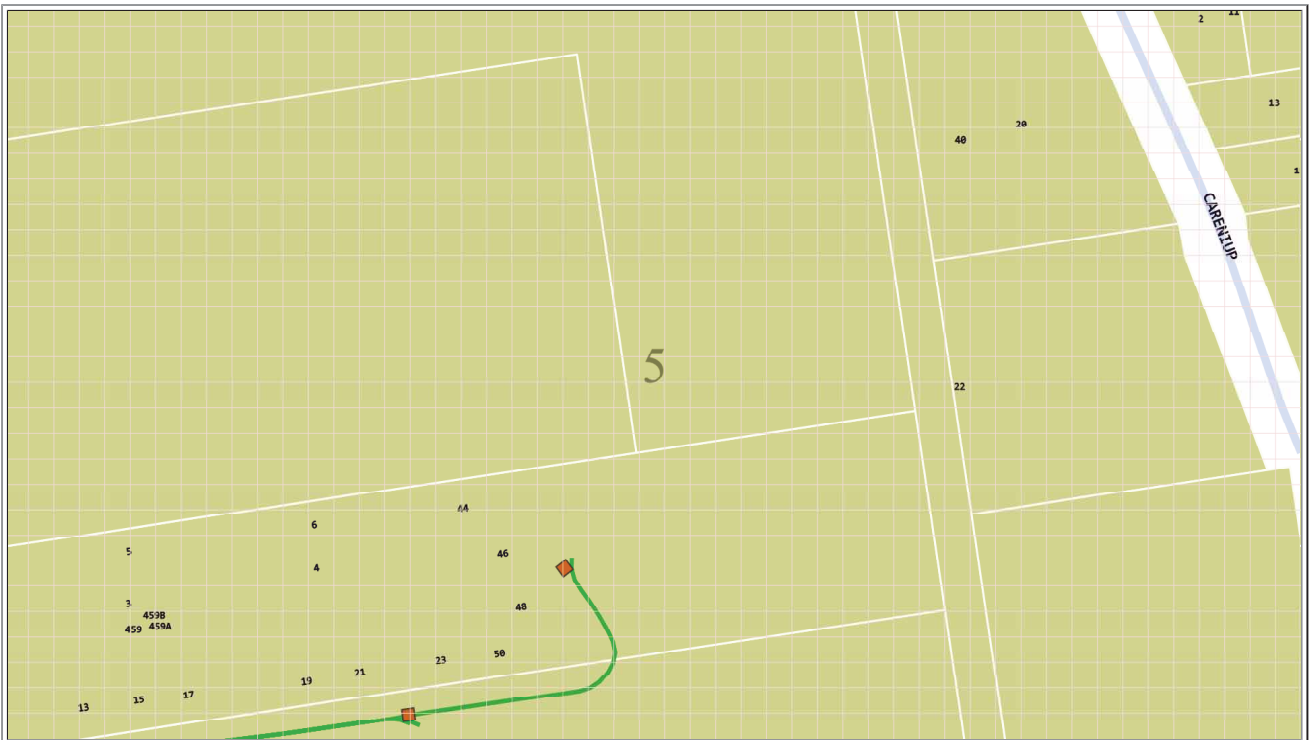


LEGEND

Type: Telco
Technology: Fibre

Assets

	IN-SERVICE: Cable/ Duct/ Trench		Pit/Menhole	<p>Scale</p> <p>0 20 40 60 Meters</p> <p>1:2000 1 cm equals 20 m</p>
	DESIGNED/CONSTRUCTED: Cable/ Duct/ Trench			



LEGEND

Type: Telco
Technology: Fibre

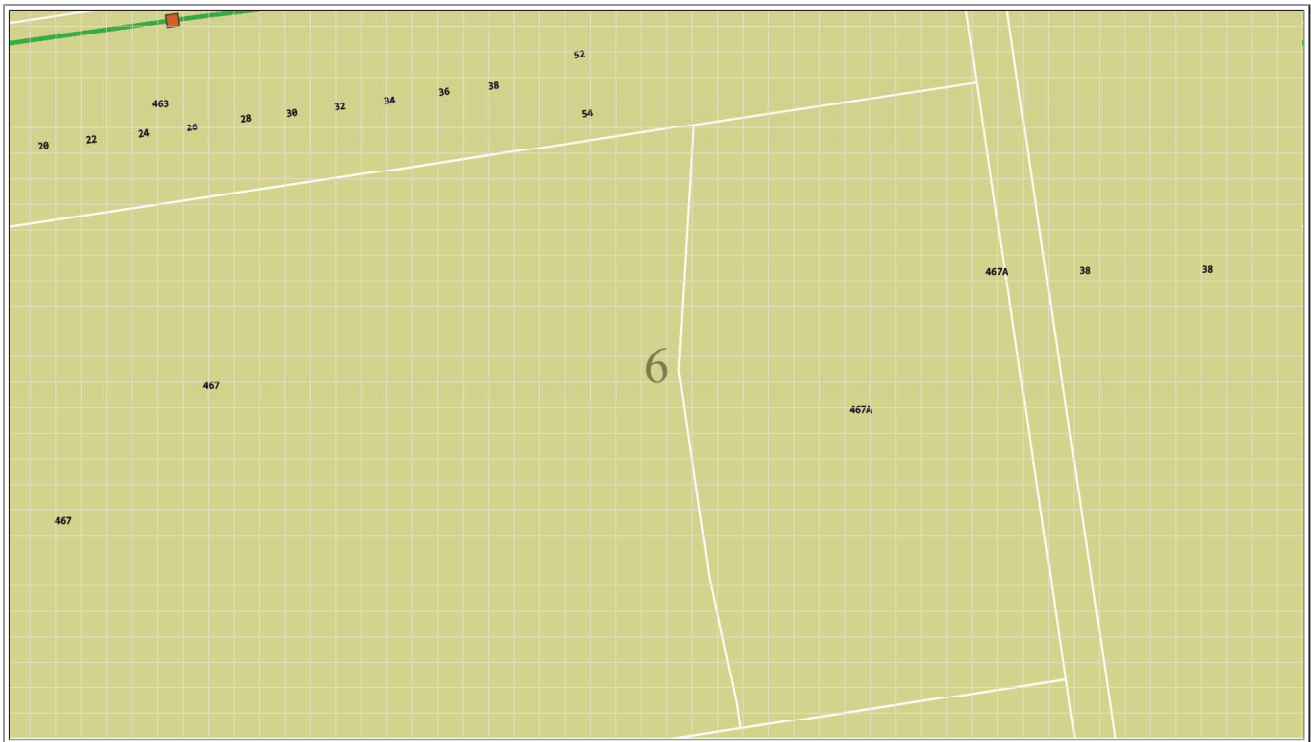
Assets

- IN-SERVICE: Cable/ Duct/ Trench
- DESIGNED/CONSTRUCTED: Cable/ Duct/ Trench
- Pit/Menhole

Scale

0 20 40 60 Meters

1:2000
1 cm equals 20 m



Emergency Contacts

You must immediately report any damage to **nbn**TM network that you are/become aware of. Notification may be by telephone - 1800 626 762.

Cable Plan



For all Telstra DBYD plan enquiries -
 email - Telstra.Plans@team.telstra.com
 For urgent onsite contact only - ph 1800 653 935 (bus hrs)

Sequence Number: 59586726

CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.

TELSTRA CORPORATION LIMITED A.C.N. 051 775 556

Generated On 13/03/2017 16:10:18

The above plan must be viewed in conjunction with the Mains Cable Plan on the following page

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

It is your responsibility to locate Telstra's underground plant by careful hand pot-holing prior to any excavation in the vicinity and to exercise due care during that excavation.

Please read and understand the information supplied in the duty of care statement attached with the Telstra plans. TELSTRA WILL SEEK COMPENSATION FOR LOSS CAUSED BY DAMAGE TO ITS PLANT.

Telstra plans and information supplied are valid for 60 days from the date of issue. If this timeframe has elapsed, please reapply for plans.

Mains Cable Plan



For all Telstra DBYD plan enquiries - email - Telstra.Plans@team.telstra.com
 For urgent onsite contact only - ph 1800 653 935 (bus hrs)

Sequence Number: 59586726

CAUTION: Fibre optic and/ or major network present in plot area. Please read the Duty of Care and contact Telstra Plan Services should you require any assistance.

TELSTRA CORPORATION LIMITED A.C.N. 051 775 556

Generated On 13/03/2017 16:10:28

WARNING - Due to the nature of Telstra underground plant and the age of some cables and records, it is impossible to ascertain the precise location of all Telstra plant from Telstra's plans. The accuracy and/or completeness of the information supplied can not be guaranteed as property boundaries, depths and other natural landscape features may change over time, and accordingly the plans are indicative only. Telstra does not warrant or hold out that its plans are accurate and accepts no responsibility for any inaccuracy shown on the plans.

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